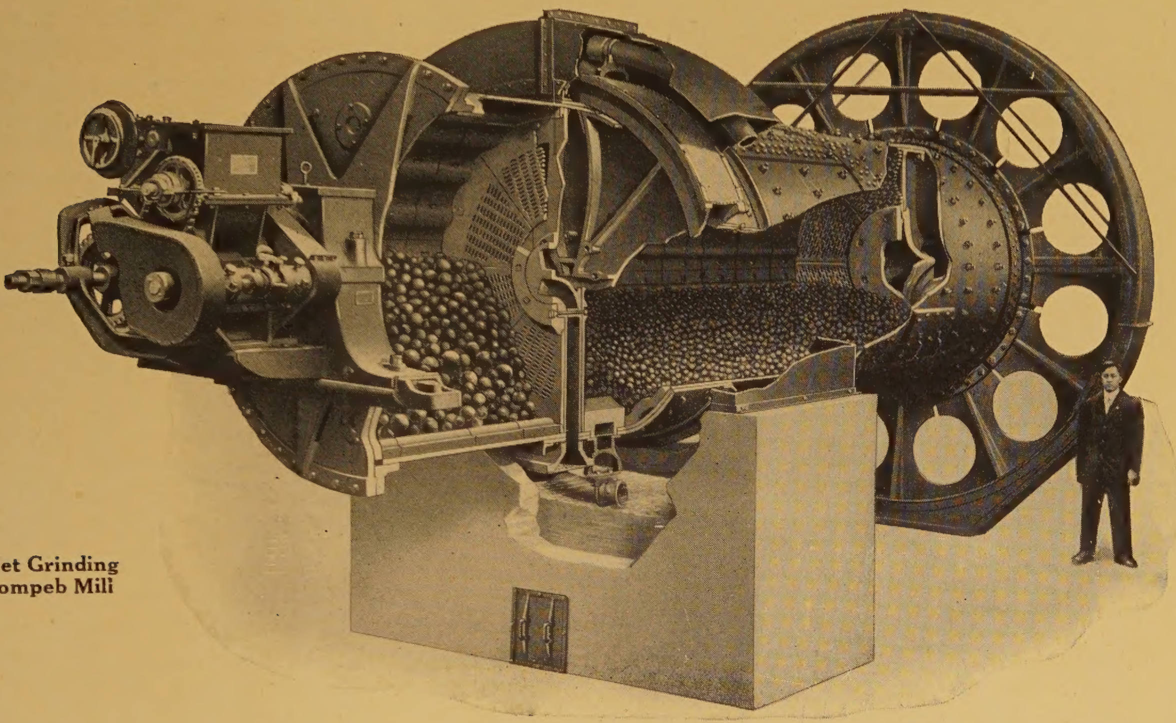
MILL SECTION of
Concrete



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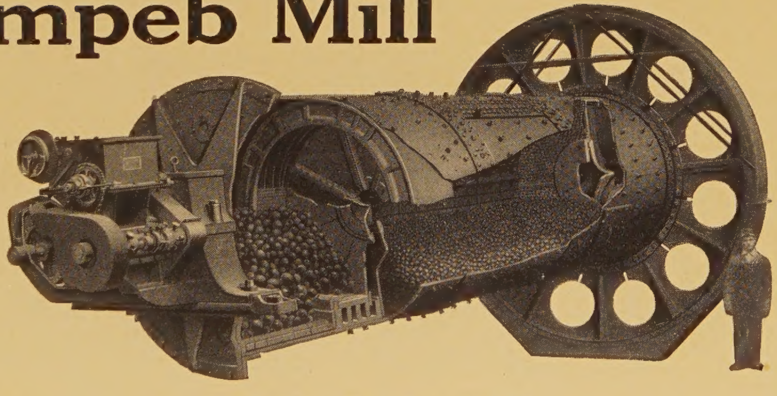

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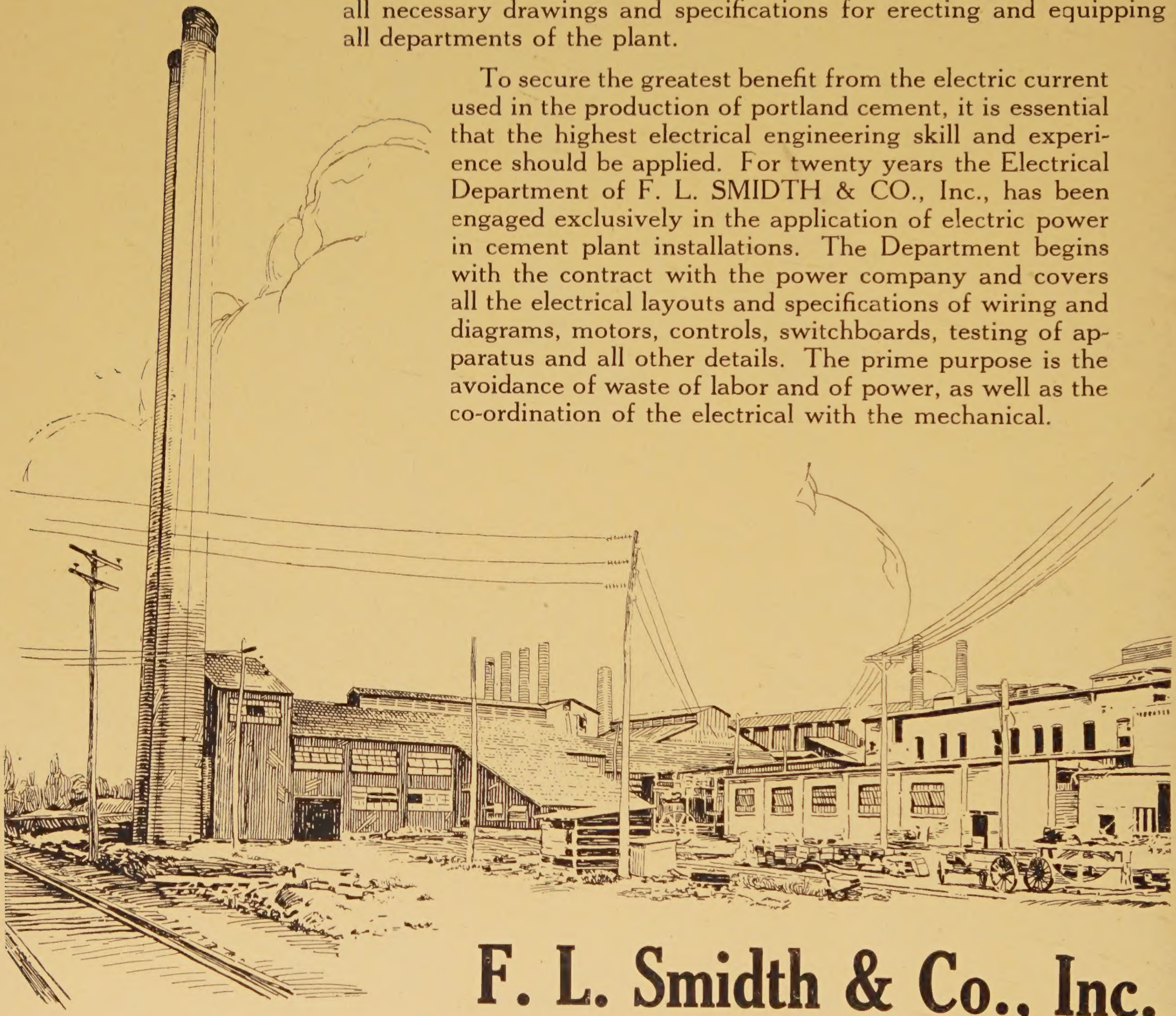

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MILL SECTION of Concrete

The Mill Edition of CONCRETE is edited for the manufacturers of portland cement, lime and similar products. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition.

The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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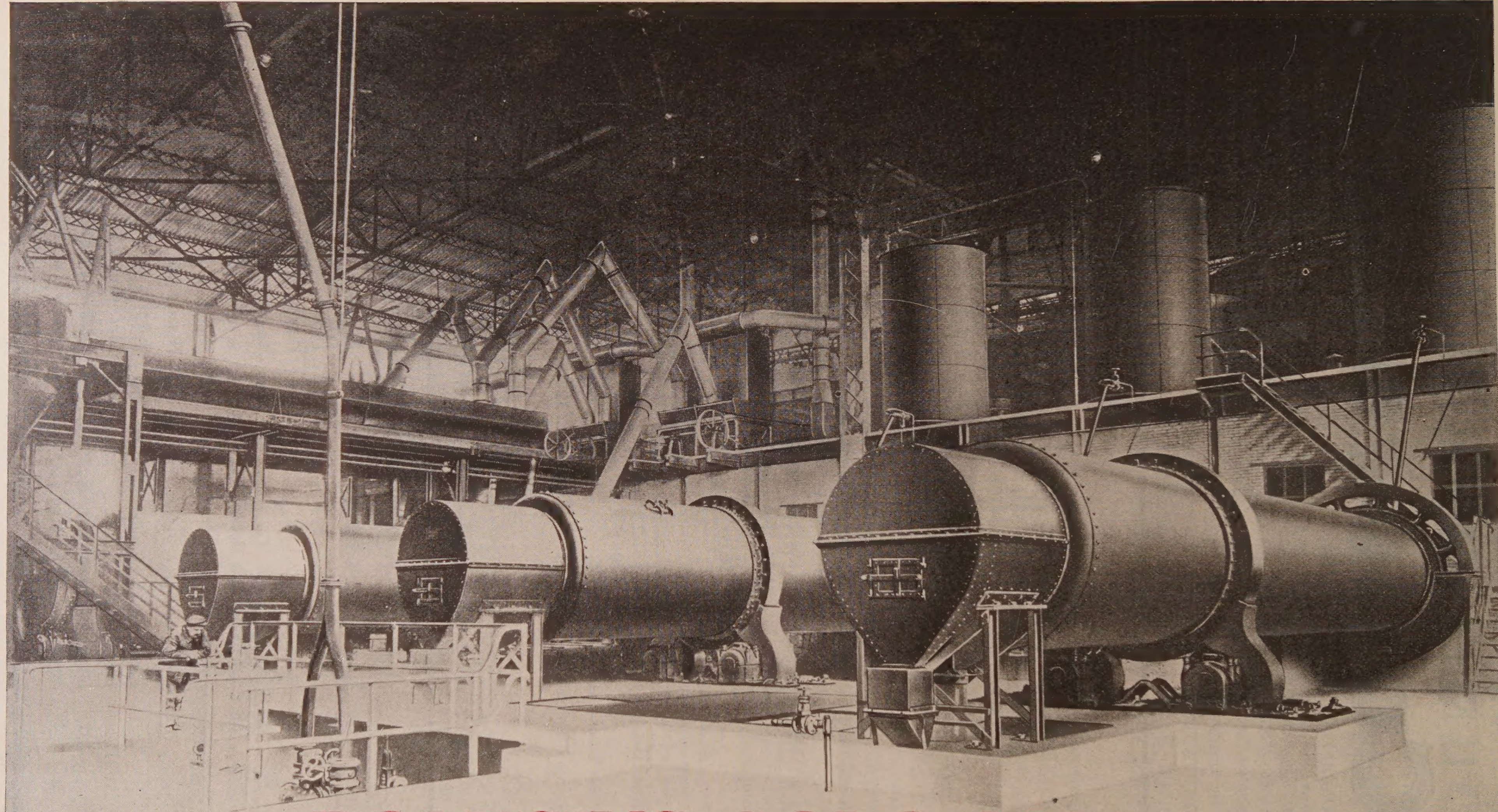

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MILL SECTION of

Concrete

Vol. 31 Chicago, July, 1927 No. 1

Commercial Cement and the Phase Diagram

A Study Developing a Graphic Subdivision of the Field $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$ Whereby the Percentages of These Compounds May Be Directly Ascertained

By W. E. HASKELL
Oakland, California

THE ternary system SiO_2-Al_2O_3-CaO has been exhaustively investigated by Rankin and Wright, and defined in their ternary phase diagram. Their work was followed by the investigations of Bates and Phillips, who studied the properties of the pure compounds which can exist in cement. Rankin and Wright find that pure cement clinker at equilibrium lies entirely in that field of the phase diagram bounded by the compounds $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$, which means that pure clinker, i. e., (that composed of the three components, SiO_2, Al_2O_3 and CaO) consists of varying mixtures of these compounds. Commercial cements also lie in this field, although imperfect equilibrium results in compounds from adjacent fields being found in the cement in small amounts. These compounds are CaO and $5CaO.3Al_2O_3$.

Although the location of commercial cement is in this field the writer knows of no graphic method by which the percentages of the three compounds may be read off from their location in the diagram, and the following study develops a graphic subdivision of the field $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$, whereby the percentages of these compounds may be directly ascertained, assuming the cement to be at equilibrium.

Use of Diagram

The percentage composition of varying hypothetical mixtures, all lying within the field, were calculated and their position plotted. Fig. 3 represents that section of the complete phase diagram with which we are concerned.

A line drawn from the apex $3CaO.Al_2O_3$, to a point of the composition 50 per cent $3CaO.SiO_2$ and 50 per cent $2CaO.SiO_2$, bisects the triangle; all points below this line have the tri-silicate as the predominating phase and those above the line predominate in the di-silicate.

In the same manner points on the silicate-aluminate lines are located and connecting lines drawn. Points within the triangle having like proportions of the respective silicates are also joined, forming when completed, co-ordinates, from which it is possible to read the proximate composition of the cement. Thus a point (A), Fig. 3, has the composition 20 per cent $3CaO.Al_2O_3$, and 50 per cent $2CaO.SiO_2$, the remainder of 30 per cent being $3CaO.SiO_2$.

The points plotted are as follows:

	MIXTURES	
Per Cent $3CaO.SiO_2$	Per Cent $2CaO.SiO_2$	Per Cent $3CaO.Al_2O_3$
50	50	----
----	90	10
----	80	20
----	70	30
90	----	10
80	----	20
70	----	30
40	40	20
30	40	30
40	50	10
30	50	20
20	50	30
30	60	10
20	60	20
10	60	30
20	70	10
10	70	20
40	30	30
50	40	10
50	30	20
50	20	30
60	30	10
60	20	20
60	10	30
70	20	10
70	10	20

The location of commercial cements involves consideration of several factors, namely, the lack of equilibrium and the presence of compounds not common to the system. As we assume the cement to be entirely within the field $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$, the presence of other phases is not considered as their amounts in well burned clinker are probably small.

Most authorities also consider Fe_2O_3 and MgO as alumina and lime respectively and this course has been followed in this study by multiplying their values by an equivalent factor.

It will be seen then that the analyses as usually reported must be re-calculated as follows:

Silica = per cent as reported.
Al_2O_3 = (per cent as reported) + (per cent $Fe_2O_3 \times 0.7$).
CaO = (per cent as reported) + (per cent $MgO \times 1.4$) — ($SO_3 \times 0.7$).

These results are then re-calculated to percentages on a three component basis.

Thus a cement having the analysis reported below, for the purpose of locating in the phase diagram becomes as follows:

	Analysis Per Cent
SiO_2	21.5
FeO_3	2.0
Al_2O_3	6.0
CaO	64.0
MgO	2.0
SO_3	1.3
Loss	2.9
	99.7

RE-CALCULATED

	Per Cent
SiO_2	21.5
Al_2O_3	7.4
CaO	65.9
Total	94.8

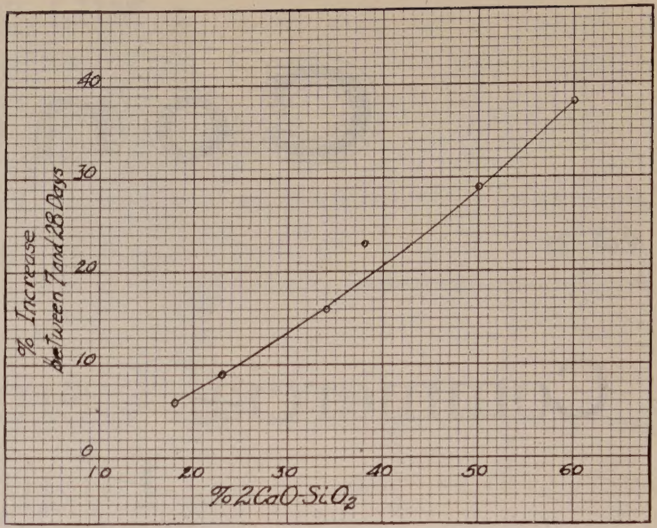


Figure 2

RE-CALCULATED TO TOTAL OF 94.8

	Per Cent
SiO_2	22.7
Al_2O_3	7.8
CaO	69.5
Total	100.0

To locate this point within the phase diagram, locate on the line CaO to Al_2O_3 a point representing 7.8 per cent numbering away from the apex CaO, from this point drawing a line parallel to the line $CaO\text{-}SiO_2$.

Add together the percentages of Al_2O_3 and SiO_2, namely, 30.5 per cent; locate this point on the line $CaO\text{-}Al_2O_3$, and draw a line from this point to the point on the $CaO\text{-}SiO_2$ line representing the percentage of lime, 69.5 per cent; the intersection of the two lines is the location of the cement in the phase diagram.

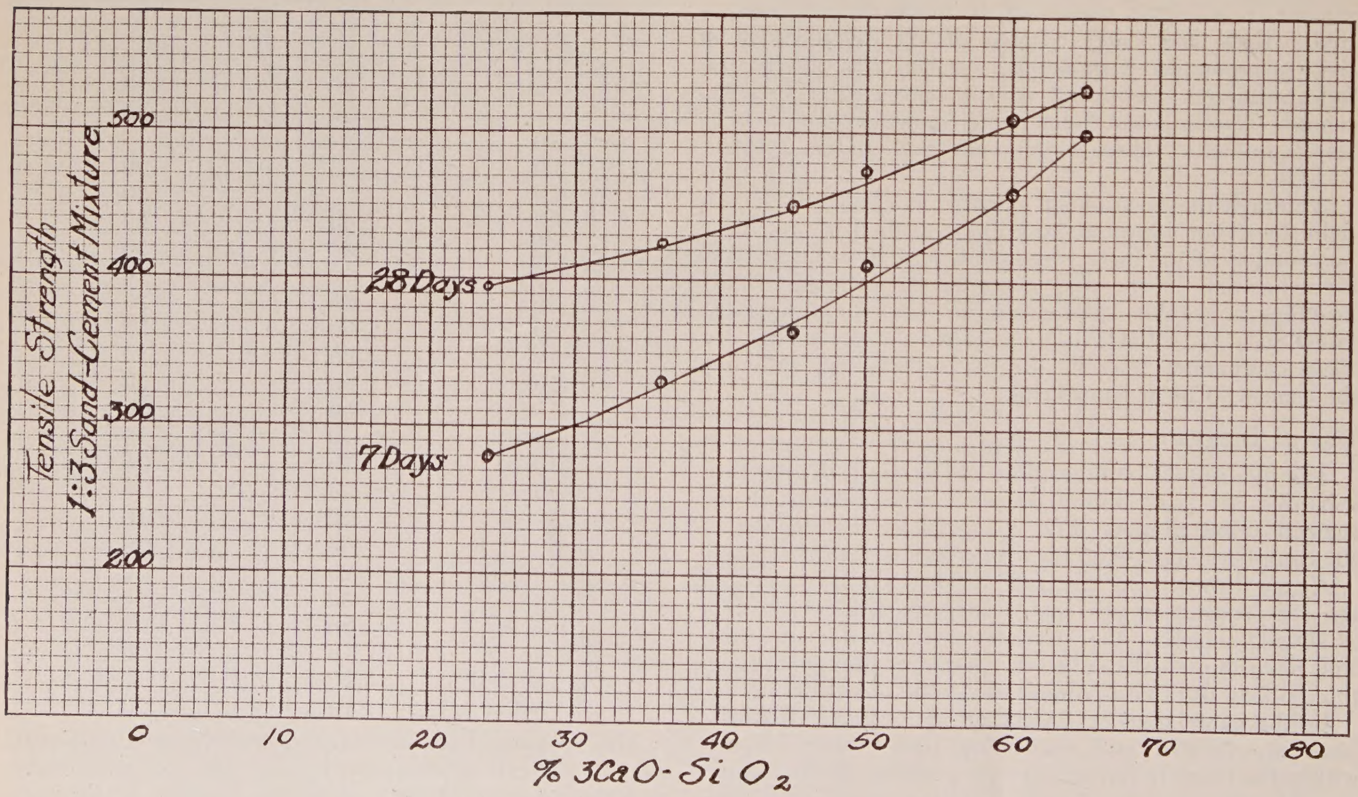


Figure 1

In an investigation subsequent to that of Rankin and Wright, Bates and Phillips investigated the properties of the three predominating phases in cement clinker. In his summation of the work of these investigators, Meade makes the following statements:

(1). "the important elements of cement so far as the hardening goes are the tri-calcium silicate and the di-calcium silicate and that alumina compounds are needed only as a flux and are of themselves of doubtful value aside from this. ($3CaO.Al_2O_3$) gains practically all its strength within 24 hours.

(2) "Bates attributes the slow hardening of cements at periods beyond 28 days to the action of this compound." ($2CaO.SiO_2$.)

(3) "Tri-calcium silicate has all the properties of cement except a slightly inferior plasticity. At early periods (7 days) it is the strongest of the three compounds. . . . Tri-calcium silicate gains its full strength before seven days."

Investigation of High Lime Cements

It was thought to be of interest to investigate the properties of six types of high lime cements, in relation to their position in the phase diagram (Points 1-2-3-4-5-6, Fig. 3) and the foregoing statements. The re-calculations of the analysis of these cements to a three component basis is as follows:

	SiO_2 Per Cent	Al_2O_3 Per Cent	CaO Per Cent
(1)	25.17	8.23	66.60
(2)	24.60	7.79	67.61
(3)	23.01	8.45	68.54
(4)	23.91	7.54	68.55
(5)	22.42	7.89	69.69
(6)	22.10	7.70	70.20

It must be remembered that these data are re-calculations from the analyses as reported, hence the abnormally high lime. From their position in the phase diagram the proximate compositions of these cements are as follows:

	$3CaO.SiO_2$ Per Cent	$2CaO.SiO_2$ Per Cent	$3CaO.Al_2O_3$ Per Cent
(1)	24	60	16
(2)	36	50	16
(3)	45	38	17
(4)	50	34	16
(5)	60	23	17
(6)	65	18	17

It will be noted that no attempt has been made to locate the cements with fictitious accuracy, and that the percentage of aluminate is fairly constant on all samples.

By plotting a curve of the tensile strength of 1-3 cement, sand mixtures against the percentages of $3CaO.SiO_2$

(Continued on page 99)

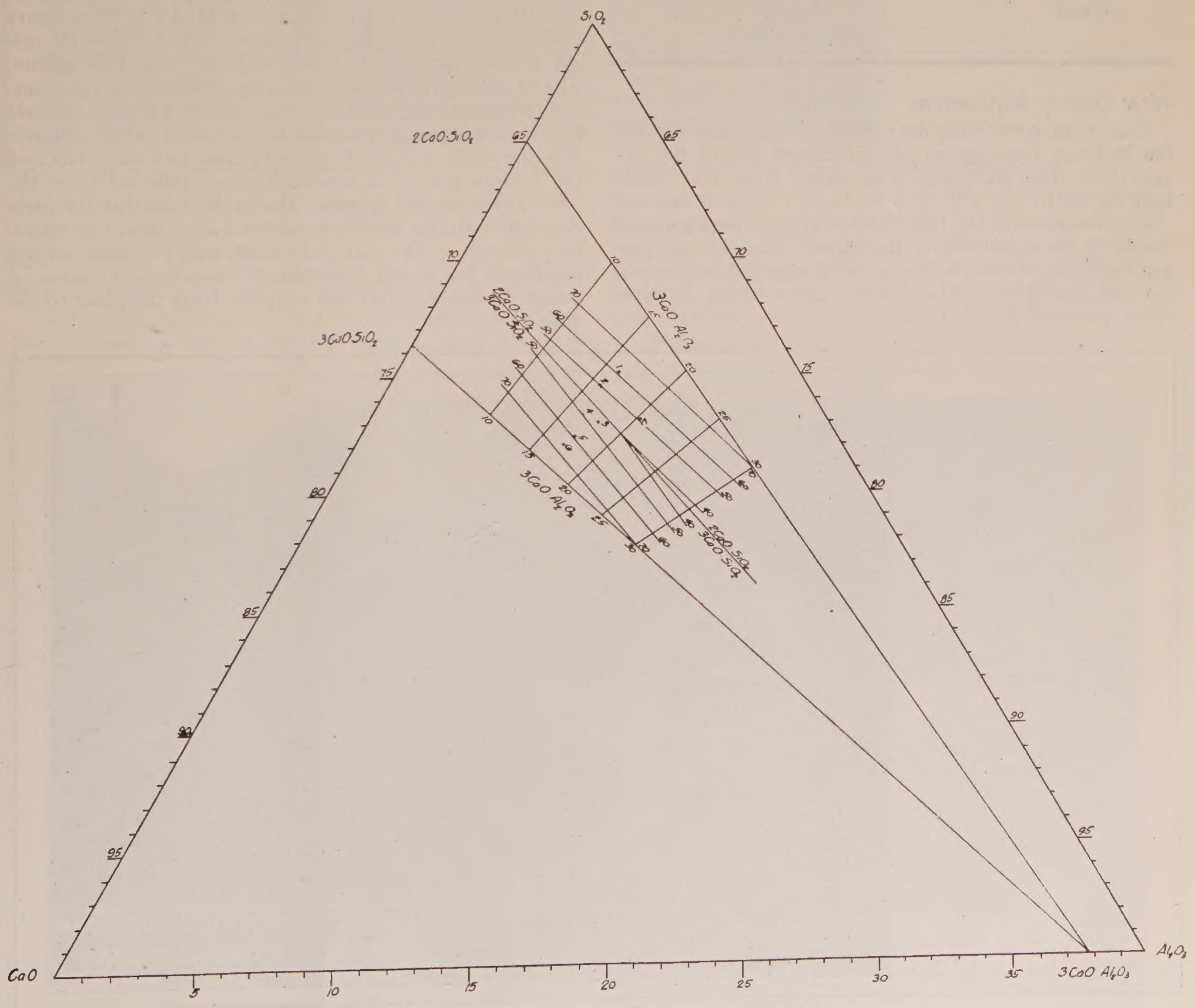


Figure 3

Old Acme Plant Completely Modernized

Work of Rebuilding Old Acme Plant at Catskill, New York, Completed—Production Increased—Manufacturing Costs Reduced—Some Details of the Work—An Unusually Important Rebuilding Project

Part II

Part I of this article, published in the June issue, described the scope of the alterations undertaken, told how the project was planned and gave an illustration of the method used for scheduling each improvement or installation. Reference to the layout charts illustrating the first installment will be of value.

In this, the concluding chapter, the details of the reconstruction program will be described.

New Quarry Equipment

Limestone, taken from the company's own quarry across the highway from the plant, constituted one of the raw materials. The other was clay, taken from clay banks near the mill.

Improvements in the raw material supply were centered chiefly in the rebuilding of the quarry crushing and storage facilities. The only change in the quarry proper was the installation of a new 100-B, full revolving Bucyrus steam powered shovel.

The quarry face is approximately 350 feet long and varies from 30 to 60 feet in height. Quarry equipment includes four Loomis clipper drills, three Ingersoll-Rand jack hammers, the new 100-B Bucyrus steam shovel with a 3½-yard bucket, a No. 45 Atlantic steam shovel, 2½-yard bucket, and a Type A Marion steam shovel equipped with a 1½-yard bucket, which is held in reserve.

The rock picked up by the shovels is taken in 12 cubic yard Western air dump cars from the quarry face to the primary crusher, which is located in the quarry. Two saddle tank locomotives—one a 29-ton Vulcan, the other a 21-ton American—pull the loaded cars to the crusher bin. Here a 48-inch Allis-Chalmers Model K-24 gyratory crusher driven by a 200-horsepower General Electric motor reduces the rock from shovel size down to 8 inches. The crushing plant has a capacity of 500 tons per hour.

Erection of this crushing plant involved a large amount of rock excavation, the installation of a 50-ton electric Whiting crane for handling equipment and materials and the construction of a standard gauge railroad from the plant tracks to the quarry. The crane installed for erection has a 10-ton auxiliary which is now used for operation purposes. The railroad is not used for transporting limestone, but is now maintained to serve as a means of taking machinery, coal and supplies from the plant to the quarry.

o—O—o

The crusher site at the Catskill plant

o—O—o

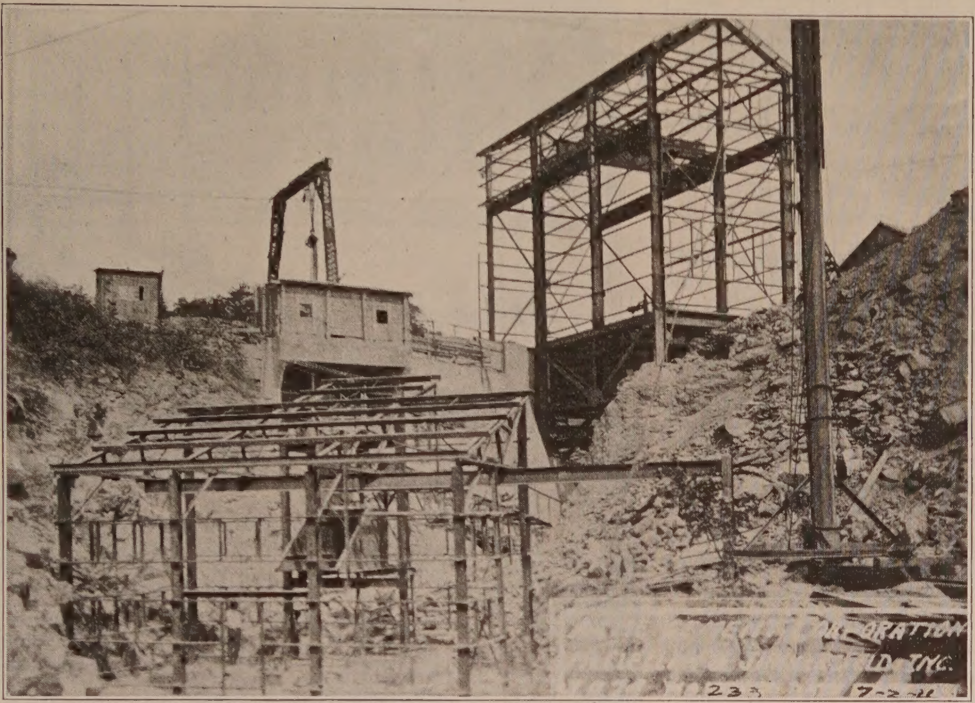
The crusher discharges onto a 40-inch variable speed belt conveyor which feeds a 200-ton capacity, No. 9 Mammoth Jr. Williams mill which reduces the rock to ¾-inch size. The mill has eighteen hammers, weighing 250 pounds each, revolving at a speed of 640 r.p.m. Before reaching the hammer mill, all tramp iron is removed from the stone by means of an iron separator magnet furnished by the Electric Controller and Manufacturing Co. The difference between crusher and hammer mill capacity is taken up by the variable speed belt.

Rock Storage

Rock leaving the hammer mill is taken up by a 30-inch Stearns conveyor belt on 370-feet centers. This conveyor discharges the ¾-inch rock into a new concrete bin, erected beside the old steel bin which has been removed.

Before the equipment described was installed, the rock was crushed in a No. 10 gyratory crusher, taken with a transfer car to the old steel bin and then reduced at the mill.

Steel hopper-bottom ore cars are spotted under the rock bins and loaded by means of four valves. A 48-ton American locomotive pulls the cars to the new combined storage facilities which will be described later. In going to storage, the cars pass over a concrete tunnel built at right angles to the storage building. The tunnel is equipped with eighteen valves. Under normal operation, the rock is taken from the tunnel directly to the rock bins over the



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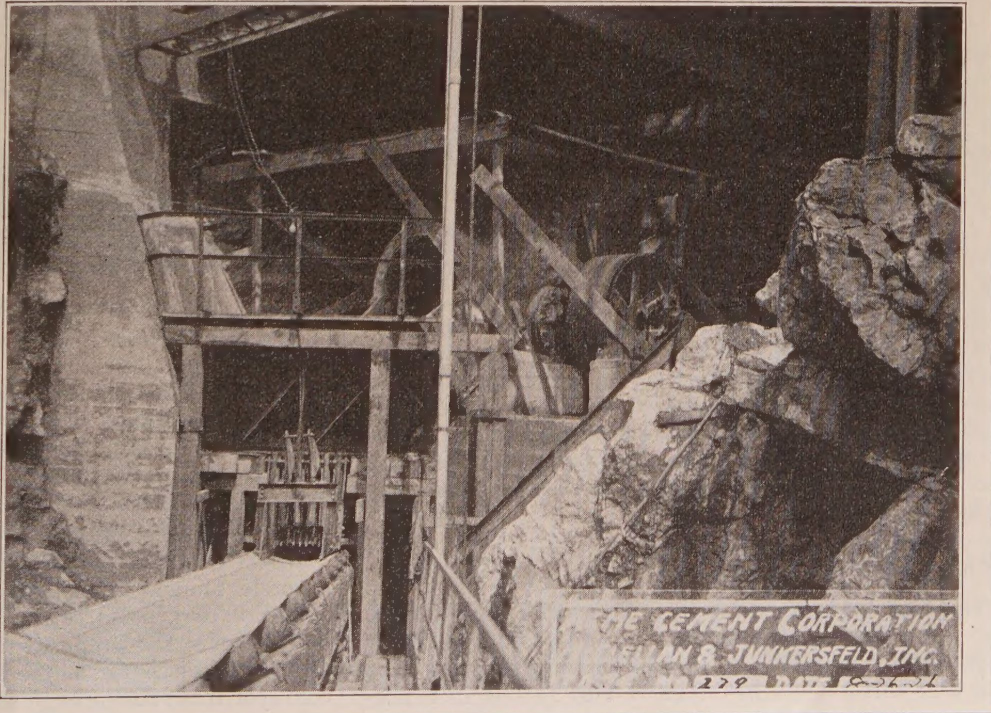
Hammer mill and crusher

o—O—o



o—O—o

The crusher discharge hopper

o—O—o

preliminators.

When an excess of rock is received, it is taken to storage by means of the 3 cubic yard Whiting crane serving the storage area. In case of deficiency of rock, the crane takes rock from storage and deposits it over the tunnel valves from which it is conveyed to the mill.

In the tunnel is a 24-inch Link-Belt conveyor, 153 feet between centers, which carries the rock through the tunnel and transfers it to another conveyor. This is an inclined Stearns belt conveyor on 220 feet centers and carries the material up the incline and discharges it into the bins over the raw mills.

All elevators and conveyors are driven through Jones speed reducers.

Grinding Department Changes

The materials are now in the rebuilt grinding room which contains all grinding equipment for both the raw and the finish ends. The room is served by a 10-ton Whiting hand crane for equipment maintenance purposes.

As remodeled, the mill room contains 2 new 8x7-foot wet grinding Allis-Chalmers preliminators which reduce the materials from hammer mill size to 20-mesh size. Here the clay and 34 per cent of water are also added.

From the preliminators the material goes down through a Belgian Silex-lined launder to two Link-Belt bucket type slurry elevators. Only one of these is needed for normal operation, the other being held in reserve. The discharges of the elevators are also lined with Silex.

Slurry agitation is accomplished by means of an F. L. Smidth horizontal agitator 40 feet long. The tank has four outlets with gate valves that deliver the slurry to the raw tube mills.

The raw grinding department consists of the two 7 x 20 feet Allis-Chalmers tube mills previously used in this department and the two 7 x 16 feet Allis-Chalmers mills that were previously used in the old finish grinding department. These last two mills were rebuilt and moved to their new location.

Before remodeling, the raw grinding equipment was located in another building and consisted of the two 7x20 mills previously mentioned, an 8x48 Hardinge mill, and an 8x7 Worthington ball mill.

Slurry Correction Tanks

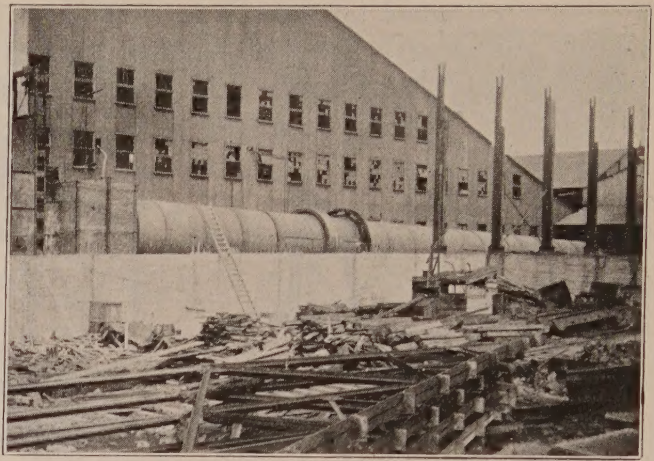
The present slurry correction tanks were previously the kiln tanks. There are four of these, each 15 feet in diameter by 24 feet high. They are equipped with both mechanical and air agitation.

From the correction tanks the slurry flows by gravity to four Dorr slurry storage tanks, each 28 feet 8 inches in diameter and 20 feet high. These tanks also have both air and mechanical agitation.

The slurry is drawn from the bottom of the Dorr tanks and pumped with two Morris centrifugal pumps to five Ferris wheel feeders which have been elevated to positions above the kiln to maintain uniform kiln feed. Each feeder is pumped to overflow so that the slurry level is accurately maintained. The overflow from all the feeders goes into a common return and is sent back to the storage tanks.

New Kiln Added

The four 8 x 180 feet Vulcan kilns with their 6 x 60 feet rotary coolers remained in their old positions. A new fifth kiln was installed parallel to the existing units. The new kiln unit is an Allis-Chalmers kiln 11 feet in diameter and 185 feet long. A fifth rotary cooler, 8 feet in diameter by 60 feet long was installed to serve this kiln. Clinker discharges from the coolers into a 12-inch manganese steel Bethlehem drag conveyor, having a capacity of 50 tons per hour. This conveyor delivers the clinker into two concrete and steel Link-Belt bucket type elevators which discharge it directly into the space in the storage building reserved for clinker. Space is provided for storing 100,000 barrels of clinker.


View of the kilns during remodeling activities

Materials Storage

A new storage building, 600 feet long and 80 feet wide was erected as part of the reconstruction program. The entire building is roofed, except for the coal storage portion.

Grinding machinery in place

A Whiting electric traveling crane, equipped with a 3 cubic yard Blaw-Knox bucket serves the entire storage area. Storage space is provided for 18,000 tons of rock, 3,000 tons of coal, 100,000 barrels of clinker and 1,000 tons of gypsum. Gypsum is taken directly from the cars by means of a Link-Belt elevator and stored in a concrete bin in the clinker storage part of the building.

Directly under the clinker and gypsum storage is a concrete tunnel. In it are four valves, two for clinker and two for gypsum. Here also are four Allis-Chalmers table feeders for proportioning the clinker and the gypsum. They discharge onto a 12-inch Bethlehem drag chain conveyor that runs through the tunnel and discharges onto an 18-inch inclined drag chain conveyor which takes the clinker to the top of the compeb mills where it is distributed to the four compeb mills.

Finish Grinding

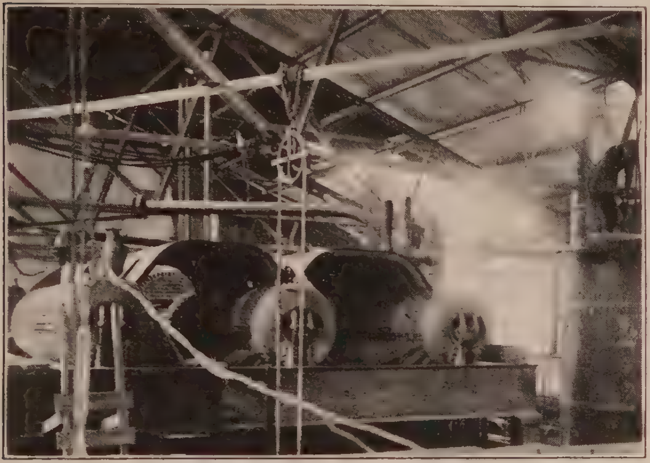
Four Allis-Chalmers No. 726 (7 feet diameter by 26 feet long) compeb mills accomplish the finish grinding. Three of these are new mills, installed in the new grinding room. The other is an older mill that was moved to its new location.

The mills discharge the cement into a 16-inch screw conveyor which in turn discharges into another 16-inch screw conveyor that carries the cement to the stock house.

No changes were made in the stock house and packing department.

Waste Heat Boiler Installation

Two new waste heat boilers were installed. Only three kilns—two of the old and the new one—are connected to the waste heat boilers. It is planned ultimately to connect the other kilns to a third boiler. The kilns are hooked up with a common flue in such a manner that the new kiln can be used to serve either of the waste heat boilers.



Upper tanks of waste heat boilers

The boilers are of special design—5 drum No. 20 modified Rust and Sterling boilers built by the Babcock-Wilcox Co. Each boiler is rated at 870 hp. They are equipped with Sturtevant steel tubes, lead-coated economizers and Sturtevant fans. Cochrane filters and a Zeolite softener were installed to soften and purify the boiler feed water.

The boiler feed pumps were placed in the old boiler room and are so arranged that they can feed either the waste heat boilers or the old coal-fired boilers which are held in reserve.

Power is generated by the two old G. E. Curtis steam turbines (1250 k.w. each) which remained in their old locations.

The control room contains a new 27-panel control switchboard with 16 departmental circuits. Each circuit has its own integrating wattmeter.

In the control room are also the four Allis-Chalmers 500-hp. synchronous motors that drive the compeb mills. Each of these has a 60-inch Cutler-Hammer magnetic clutch with shaft drives extending through the wall into the grinding mill room.

Other equipment installed in the control room includes a motor generator set for furnishing excitation to all the synchronous motors and to the turbines and a Chicago Pneumatic Tool Co. air compressor (185 hp. 1010 cu. ft.) for supplying air to the air lift pumps, to the Fuller-Kinyon system and for slurry agitation.

Coal Room

Improvements in the coal room included the replacement of the old screw conveyors by a Fuller-Kinyon system with automatic signaling and control. An old 57-inch Fuller mill that was formerly used for grinding clinker was set in line with the three 42-inch Fuller mills in the coal room. Steel platforms and stairways were erected to replace the old wooden structures.

A 100,000-gallon steel tank was erected to provide adequate fire protection. It operates in connection with the main service system. There are two pumps supplying the tank, one of these being a Triplex pump used in ordinary plant operation. In case of emergency a centrifugal pump is placed in action.

Shops and Storage Building

The entire plant was also completely rewired and all electric wiring was placed in conduits.

The present shops and storage building was originally erected for a raw grinding room but was never used. To adapt it to its new use, the building was divided lengthwise into two equal sections. One section is the machine shop and the other the storeroom.

In addition to the main floor in the storeroom, there are two mezzanines.

It is planned to erect a new laboratory over the front end of the machine shop and a complete wash and change room over the storeroom.

These are the bare prosaic facts of the work done in remodeling the plant. In them there is no indication of the skillful and careful planning and scheduling that was necessary to complete such a project without curtailing production. How that program was planned and carried out was described in the previous article. All the work was completed as scheduled. The mill maintained maximum production throughout the work and the rebuilt plant left the ranks of the not-so-goods and entered production with the better plants of today.

Commercial Cement and the Phase Diagram

(Continued from page 95)

(Fig. 1) it will be seen that the strengths at both 7- and 28-day periods increase with the percentage of $3CaO.SiO_2$. With a percentage of 65 per cent $3CaO.SiO_2$, the progressive gain between 7 and 28 days is only 30 pounds, showing very clearly that a cement in which $3CaO.SiO_2$ is strongly predominant will reach its strength at an early period.

Fig. 2 shows the progressive gain in percentage with increasing quantities of $2CaO.SiO_2$. Although Bates states that hardening after 28 days is due to $2CaO.SiO_2$, it seems probable that it may also be the cause of the progressive gain from 7 to 28 days.

As most manufacturers and engineers prefer a cement having a substantial progressive gain, it seems desirable to so proportion the components as to secure about equal parts of the two silicates as recommended by Meade.

Summary

(1) A graphic division of the field $3CaO.SiO_2$, $2CaO.SiO_2$ and $3CaO.Al_2O_3$ is developed, whereby it becomes possible to read off the proximate composition of cements from their location in the phase diagram.

(2) The tensile strength of six types of cement is considered in relation to their location in the phase diagram.

Power Plant and Kiln Design and Operation

A Series of Articles on the Combined Processes of Power Plant and Kiln Operation Considered as a Unit

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Chapter IX.—Heat Balance in the Kiln

Fuel Consumption Is Largest Single Item of Manufacturing Cost—Determining Heat Losses—Dust Losses—Kiln Heat Requirements—Calculation of Flame Temperature—Heat Balance in the Burning Zone—Heat Balance for a Rotary Kiln Test

FUEL consumption in burning clinker is usually the largest single item in cement manufacturing cost. A technical analysis of the disposition of the heat provided by the fuel is the only accurate method whereby we may determine which of the losses can be reduced or eliminated without undue expense and without complicating the process.

The rotary kiln has four distinct zones in which work is performed at successively higher heat levels, as the material passes through the kiln. Even in the dry process, the material carries some moisture. In the wet process the moisture content becomes quite a large factor. Thus the length of the drying zone will vary with the moisture content.

After the moisture is driven off, the material passes to the calcining zone where the carbon dioxide is driven off from the calcium and magnesium carbonates. The magnesium carbonate is broken up at a lower temperature than calcium carbonate. Thus the carbon dioxide begins to pass off very shortly after the drying is complete. It is probable that owing to the high heat of the gases and the insulating qualities of the surface of dried materials, that a portion of the materials on the surface may be calcined partially before the mass is entirely dry.

No sharp line of demarcation can therefore exist between these zones. There is a gradual transition from one to the other and the relative length and position of the zones may vary as the composition and moisture content or fuel material ratio may vary from time to time. The disassociation of the gas will become quite active when the material reaches a temperature of 1300 deg. F. and will be practically complete at 1700 deg. F. Heating curves show a distinct break at these points.

The theory has been advanced that too rapid evolution of the gas will project the dust particles in the gas stream. If the gas velocity is sufficient to maintain these particles in suspension they will be carried out with the gases. Thus the evolution of the carbon dioxide may have an important bearing upon the dust loss. A study of this factor may result in a considerable reduction in this loss.

Dust Losses

The wide variation in the dusting of various kilns would indicate the desirability of locating the reason and applying a remedy for this variation, in those cases where dusting is excessive. Evald Anderson gives losses from various kilns as determined by the Western Precipitation Co., as follows:

WET PROCESS

Plant	Size of Kilns in Feet	Dust Loss in Pounds per Barrel
No. 1	6½x 78	40
No. 2	7½x125	50
No. 3	8 x125	20
No. 4	10 x175	55
No. 5	9 x200	45

DRY PROCESS

Plant	Size of Kilns in Feet	Dust Loss in Pounds per Barrel
No. 1	7 x110	25
No. 2	8 x125	34
No. 3	10 x150	53
No. 4	7 x180	32

On the basis of the above results there does not appear to be any merit to the contention that the wet process will reduce the dust loss. The determining cause must be something other than the use of the wet or the dry process.

After the material is calcined the temperature rises rapidly during the transition from the calcining to the burning zone. The burning temperature will vary somewhat with the composition of the mix, but for the average well-burned clinker the material must be brought to 2600 deg. F. The burning zone is short as compared with the drying and calcining zones. When the material is brought to the clinkering temperature, the heat of formation is given off as the combinations are formed. This will cause a rapid rise in temperature as the process starts. The heat soon becomes intense and the actual clinkering is done in a few feet of the kiln.

After clinkering is complete, the material passes through a cooling zone where a portion of the heat in the clinker is transmitted to the air induced for combustion. The length of this zone is determined by the design of the burning equipment. In some of the recent developments, the flame is thrown well back in the kiln, giving quite a long cooling zone with a high recovery of the heat in the clinker.

Kiln Heat Requirements

In Chapter IV, an analysis was made of the results of a combined kiln and boiler test. In this analysis the disposition of the heat delivered in the waste gases was discussed in detail. The total heat absorbed in the kilns was determined but no attempt was made to analyze the heat requirements in the kiln itself. The following discussion covers the calculation and disposition of the heat in the various processes performed internally in the kiln. In order to eliminate large figures and simplify the calculations, the results have been reduced to the output per kiln per second.

The combustion space of a rotary kiln is similar to any other combustion chamber for powdered fuel, in that the quantity of fuel which may be burned efficiently in a given time will vary with the cubical content of the combustion space. Or to state this in a different manner, the velocity of the gases in the burning zone will largely determine the fuel efficiency and the output of the kiln. In checking theoretical flame temperatures and gas velocities it may be shown that the limits for economical burning will lie in the range of gas velocities between 20 and 30 feet per second in the burning zone. An attempt to burn more fuel will result in higher gas velocities which may readily be increased beyond the velocity of flame propagation, with consequent incomplete combustion. The fuel efficiency will drop off till the increase in the losses will compensate for the extra fuel fed and the temperature and the output will fall off. Or, as the burner will put it, the kiln cooled off and the feed had to be cut, so the kiln was shut down for heating. Even with careful checking for efficient combustion, a point will be reached where an increase in fuel cannot be accompanied by complete combustion.

The most efficient operating results and the greatest annual output will be obtained when the economic limits have been determined and the kiln operated uniformly at that point. This will reduce the time loss for heating and will result in a more uniform product.

Calculation of Flame Temperature

The resultant gases, calculated from the combustion per pound of coal as burned with 25.7 per cent of excess air, will be as follows:

$$\frac{7150 \text{ lbs. per hour}}{3600} = 1.9861 \text{ lbs. per second.}$$

The weight of the gases formed during combustion will be:

	Lbs. Gas per lb. of Coal	Lbs. of Gas per Sec.
Carbon dioxide	2.4580	4.8818
Oxygen	.5171	1.0270
Nitrogen (6.8852+1.7213+.0140)	8.6105	17.1013
Sulfur dioxide	.0080	.0159
Water (.3915+.1312)	.5227	1.0381
Ash	.1970	.3913

Thus having the weight of each of the gases and the heat available for raising the temperature, we might obtain the theoretical flame temperature if there were no radiation or heat transfer to the material or to the walls of the combustion space. The flame temperature is calculated as follows:

$$\begin{array}{lll}
CO_2 & = 2.4580\,(.19t + .00006t^2) & = .46702t + .0001474800t^2 \\
O_2 & = .5171\,(.2104t + .0000104t^2) & = .10880t + .0000053778t^2 \\
N_2 & = 8.6105\,(.2405t + .0000119t^2) & = 2.07083t + .0001024649t^2 \\
SO_2 & = .0080\,(.125t + .0000611t^2) & = .00100t + .0000004888t^2 \\
H_2O & = .5227\,(.42t + .000103t^2) & = .21953t + .0000538381t^2 \\
\text{Ash} & = .1970\,(.19t + .00039t^2) & = .03743t + .00007683t^2 \\
\hline
 & 11{,}585 \text{ B.t.u.} & = 2.90461t + .0003867998t^2
\end{array}$$

Solving this equation for "t" we have:

$$t = \frac{2.90461 \pm \sqrt{2.90461 - 4(-11585 \times .0003867998}}{2 \times .0003867998}$$

t = 2882 deg. F. which will be the theoretical temperature of the flame.

The volumes of the gases are calculated from the gas weights per second as given above and the specific volume of the gases, as follows:

	Lbs per Sec.		Cu. Ft. per Lb. at 32 deg. F.		Cu. Ft. per Sec. at 32 deg. F.
CO_2 =	4.8818	×	8.103	=	39.56
O_2 =	1.0270	×	11.209	=	11.51
N_2 =	17.1013	×	12.809	=	219.05
SO_2 =	.0159	×	5.475	=	.09
H_2O =	1.0381	×	18.7558	=	19.47
					289.68

We thus have a volume of 289.68 cubic feet of gas per second at normal temperature and pressure from the combustion of the coal. To obtain the volume at 2882 deg. F., we have:

$$\frac{289.68 \times (2882 + 458)}{32 + 458} = 1975 \text{ cubic feet per second at 2882 deg. F. and 29.92 inches of mercury.}$$

The diameter of the burning zone in this particular case was 11 feet 6 inches, with 9 inches of fire brick lining and 3 inches of coating. The effective area was 70.88 square feet. The gas velocity in the burning zone is, therefore:

$$\frac{1975}{1.9861} = 27.86 \text{ feet per second.}$$

The cubic feet of gas per pound of coal is:

$$\frac{1975}{1.9861} = 995 \text{ cu. ft. of gas per lb. of coal at 2882 deg F.}$$

The velocity of the gases will thus be within the economic limits and the heat efficiency of the kiln should be high except for the excess air which could be reduced somewhat.

Heat Balance in the Burning Zone

The calculation of the various items comprising the heat balance in the various processes of burning will now be given.

(1) The thermal value of the heat in the coal will form the greatest single item of heat introduced into the kiln. The heat available from the combustion of the coal per second, is:

$$1.9861 \times 11{,}585 = 23{,}009 \text{ B.t.u. per second.}$$

(2) The coal is admitted to the kiln at a temperature of 150 deg. F. and thus carries with it a certain amount of sensible heat. The specific heat of the coal is .314. The sensible heat admitted with the coal with 0.5 per cent moisture is then:

B.t.u. per sec.

Heat in coal $= 1.9861 \times .314 \times (150 - 32) = 74$

Heat in water $= .005 \times 1.9861 \times 118.3 = 1$

Total 75

(3) The air used in the combustion will carry some heat into the kiln, especially that which is induced through the cooler. As nearly as could be ascertained, the air was admitted as follows: 46.8 per cent through the cooler, at 800 deg. F.; 43.2 per cent with the coal in the blast pipes, and 10 per cent in the form of infiltration through the inspection doors and at other openings. The latter two sources admit the air at room temperature of 80 deg. F.

The heat content of the air admitted through the cooler will be:

$.468 \times 22.3533 = 10.4613$ pounds of air at 800 deg. F.

$10.4613 \times 194 = 2029$ B.t.u. with the air.

$.1220 \times 410 = 50$ B.t.u. with the moisture in the air.

Total.............. 2079 B.t.u.

(4) The heat in the air leakage is:

$2.2353 \times 18 = 40$ B.t.u. per second with air at 80 deg. F.

$0.0261 \times 36 = 1$ B.t.u. per second with moisture in air.

Total .... 41 B.t.u. per second.

The heat in the air with the coal is:

$10.8459 \times 18 = 195$ B.t.u. in the air with the coal at 80 deg. F.

$.1125 \times 36 = 4$ B.t.u. in the moisture in the air.

Total 199

(5) The heat of reaction in forming the chemical combinations will evolve 100 gram calories per gram of clinker formed.

$100 \times 1.8 = 180$ B.t.u. per pound of clinker formed.

$180 \times 5.4902 = 988$ B.t.u. per second derived from the reaction.

(6) The heat returned to the kiln by reducing the temperature of the clinker from 2500 to 2000 deg. F. is:

$5.4902\ [.19(2500 - 2000 + .000022(2500^2 - 2000^2)] = 793$ B.t.u. per second.

(7) The latent heat of evaporation of the moisture formed in the combustion of the coal is:

$.7776 \times 970.4 = 755$ B.t.u. per second.

The latent heat of evaporation of the moisture with the coal is: $.0099 \times 970.4 = 10$ B.t.u. per second.

Total ....765 B.t.u. per second.

(8) The heat absorbed in raising the temperature of the calcined materials from the calcining temperature to the burning temperature or from 1700 to 2500 deg. F. is:

$5.4902\ [.19(2500 - 1700) + .000022(2500^2 - 1700^2)] = 1241$ B.t.u. per second.

(9) The heat radiated from the shell in the burning zone is calculated from the temperature difference and the area, as follows: The average temperature difference throughout the burning zone was 500 deg. F. The outside area of the burning zone is 1797 square feet. The loss in B.t.u. per square foot per hour from Darling's curve is 2590. The total radiation is then:

$$\frac{1797 \times 2590}{3600} = 1293 \text{ B.t.u. per second.}$$

These items cover the sources of the heat introduced into and removed from the burning zone. The difference between the sum of the heat introduced and the heat absorbed or removed will be the heat remaining in the gases passing to the calcining zone. No heat will be introduced in this zone and the heat for calcining will be as follows:

(10) The pounds of carbon dioxide from the calcium carbonate will be $.3221 \times 8.7869 = 2.8303$ and from the magnesium carbonate it will be $.0368 \times 8.7869 = .3033$.

The heat for calcining the mix will then be:

$2.8303 \times 1.8 \times 1026 = 5226$ B.t.u. per sec. from the calcium carbonate and

$.3233 \times 1.8 \times 666 = 388$ B.t.u. per sec. from the magnesium carbonate.

Total .... 5514 B.t.u. per sec.

(11) The heat radiated from the shell in this zone is calculated in the same manner as for the burning zone. The average difference in temperature was 200 deg. F. The area of the shell is 1940 square feet. The loss at this temperature is 532 B.t.u. per square foot per hour. The radiation is then:

$$\frac{1940 \times 532}{3600} = 287 \text{ B.t.u. per second.}$$

The difference between the heat in the gases passing to the calcining zone and the heat removed will be the heat available for drying the moisture from the raw mix. Some heat will be admitted in the sensible heat of the raw materials and the water in the slurry.

(12) The sensible heat in the raw materials will be: $8.7814\ [.19 \times 80 + .000022(80^2)] = 133$ B.t.u. per second with the raw materials at 80 deg. F.

(13) The sensible heat in the water in the slurry is: B.t.u. per pound of water at 80 deg. F. is 48.

$5.0919 \times 48 = 244$ B.t.u. per second with the water at 80 deg. F.

(14) The heat for raising the temperature of the raw materials from 80 deg. F. to 212 deg. F. is:

$5.4902\ [.19(212 - 80) + .000022(212^2 - 80^2)] = 137$ B.t.u./sec.

(15) The heat for raising the temperature of the water in the slurry from 80 deg. F. to 212 deg. F. is:

B.t.u. per pound of water at 212 deg. F. = 180

B.t.u. per pound of water at 80 deg. F. = 48

$5.0919\ (180 - 48) = 672$ B.t.u. per second.

(16) The latent heat of evaporation of the water in the slurry will be:

$5.0919 \times 970.4 = 4941$ B.t.u. per second.

(17) The radiation from the kiln shell in the drying zone will be as follows:

Temperature difference average 100 deg. F.

B.t.u. per hour per sq. ft. from Darling's curve = 260.

$$\frac{1940 \times 260}{3600} = 140 \text{ B.t.u. per second.}$$

The summary of these sources of heat introduced and heat absorbed or removed in the various portions of the kiln constitute the heat balance. The totals have been checked against the calculated heat remaining in the kiln exist gases as given in Chapter IV. The heat unaccounted for, amounting to 130 B.t.u. per second or, expressed in per cent of the total heat introduced into the kiln, as 0.47 per cent, shows a close check. Where so many factors have not been accurately determined, an absolute check is out of the question and a commercial test with so small an error may be considered quite accurate. The specific heat of the clinker is subject to considerable variation in the particular results followed. The latent heat of fusion may have some effect as yet not definitely determined.

Heat Balance for Rotary Kiln Test

				—Heat Introduced—		—Heat Removed—	
	Burning Zone	Lbs. per Sec.	Temp. F.	B.t.u.	Per Cent	B.t.u.	Per Cent
(1)	Thermal value of coal	1.9861	2882	23,009	83.48		
(2)	Sensible heat in coal	1.9861	150	75	.27		
(3)	Heat in air through cooler	10.4613	800	2,079	7.54		
(4)	Heat in air infiltration at openings	2.2353	80	41	.15		
	Heat in air with coal	10.8459	80	199	.72		
(5)	Heat of reaction	5.4902	2500	988	3.58		
(6)	Heat returned in cooling clinker in kiln	5.4902	2500-2000	793	2.88		
(7)	Latent heat of evap. of water from com.	.7875	212			765	2.78
(8)	Raising temperature of calcined material	5.4902	1700-2500			1,241	4.50
(9)	Radiation from shell of burning zone		580			1,293	4.69
	Total for burning zone			27,184	98.62	3,299	11.97
				3,299	11.97		
	Heat Available for Calcining			23,885	86.65		
(10)	Heat for calcination	3.1536	1700			5,514	20.01
(11)	Radiation from shell		280			287	1.04
	Total for calcining zone			5,801	21.05	5,801	21.05
	Heat Available for Drying			18,084	65.60		
(12)	Sensible heat in dry raw materials	8.7814	80	133	.48		
(13)	Sensible heat in water in slurry	5.0919	80	244	.89		
(14)	Heat for raising temperature of raw mix	5.4902	80-212	1		137	.50
(15)	Heat for raising temp. of water in slurry	5.0919	80-212			672	2.44
(16)	Latent heat of evap. of water in slurry	5.0919	212			4,941	17.93
(17)	Radiation from shell		180			140	.51
	Total for drying zone			18,462	66.97	5,890	21.38
				5,890	21.38		
				12,572	45.59		
	Unaccounted for			131	.46		
	Heat in exit gases			12,441	45.14		
	Total heat in kiln			27,562	100.00	14,990	54.40

The item of radiation in this test is thus a very considerable item of fuel loss. The total radiation is 1720 B.t.u. per second, or 6.24 per cent. This is made on a kiln with Silocel insulation in the calcining zone. In an uninsulated kiln the losses will be much larger.

The latent heat of evaporation of the water in the kiln is quite a large loss. This comes from two sources. The loss from the water vapor formed during combustion cannot be prevented. The loss from the water in the slurry may be prevented or reduced by the dehydration of the slurry. This loss will be:

	B.t.u.	Per Cent
Latent heat of evaporation of water from combustion	765	2.78
Latent heat of evaporation of water in the slurry	4941	17.93
	5706	20.71

The loss in the waste gases leaving the kiln is 12,441 B.t.u., or 45.14 per cent. These losses form a promising field for investigation in the further reduction in the fuel consumption of the rotary kiln. Summarizing these losses, we have a total of 72.14 per cent of the heat fed into the kiln.

		Per Cent
(9+11+17)	Radiation loss	6.24
(7)	Latent heat in water of comb.	2.77
(16)	Latent heat in water of slurry	17.93
	Loss in waste gases	45.14
		72.08

It is true that in many cases the waste heat in the exit gases is reclaimed in the waste heat boiler. This is an effort in the right direction and should be followed by more intensive effort toward the solution of the problem of further reduction in these losses.

Mechanical Engineers' Nominations Made

Nominations for officers of The American Society of Mechanical Engineers for 1928 were announced at a recent meeting of the Nominating Committee held at White Sulphur Springs, W. Va. Election will be by letter ballot of the entire membership, closing on September 27, 1927.

The nominees, as presented by the Regular Nominating Committee of the Society are: President, Alexander Dow, President, Detroit Edison Company, Detroit, Mich.; Vice-Presidents, John H. Lawrence, Vice-President and Engineering Manager, Thomas E. Murray, Inc., New York, N. Y.; Newell Sanders, Newell Sanders Plow Co., Chattanooga, Tenn.; Edward A. Muller, Vice-President and General Manager, King Machine Tool Co., Cincinnati, Ohio; Paul Wright, Paul Wright & Co., Birmingham, Ala.; Managers, William A. Hanley, Chief Engineer, Eli Lilly & Co., Indianapolis, Ind.; Luther B. McMillan, Chief Engineer, Johns-Manville, Inc., New York, N. Y., and Fred H. Dorner, Milwaukee, Wis.

Plant of Florida Portland Cement Company Scheduled for Completion Before Fall

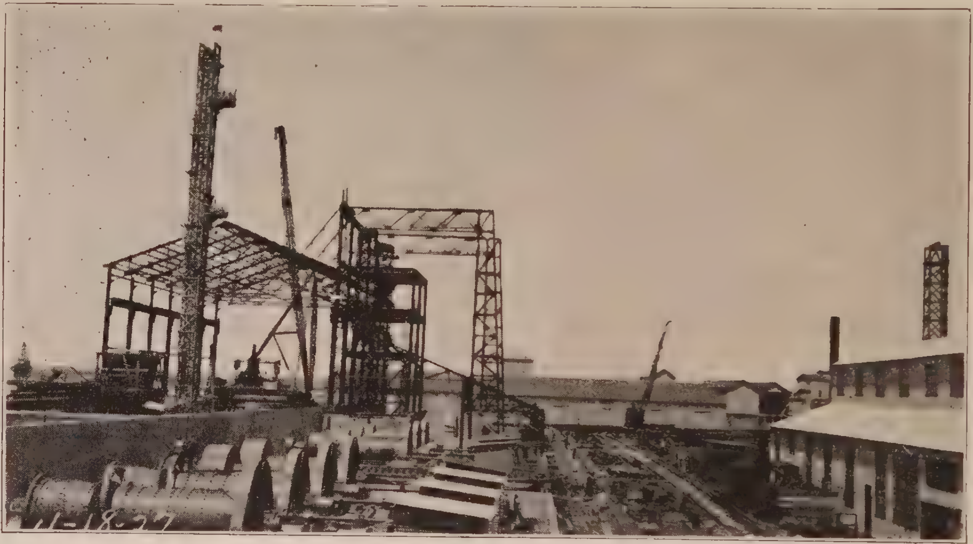
Florida's first cement plant is rapidly nearing completion. Present plans schedule the beginning of operations before fall.

The plant, which was described in detail in the Mill Section of "Concrete" for September, 1926, is located at Hookers Point, inside the city limits of Tampa.

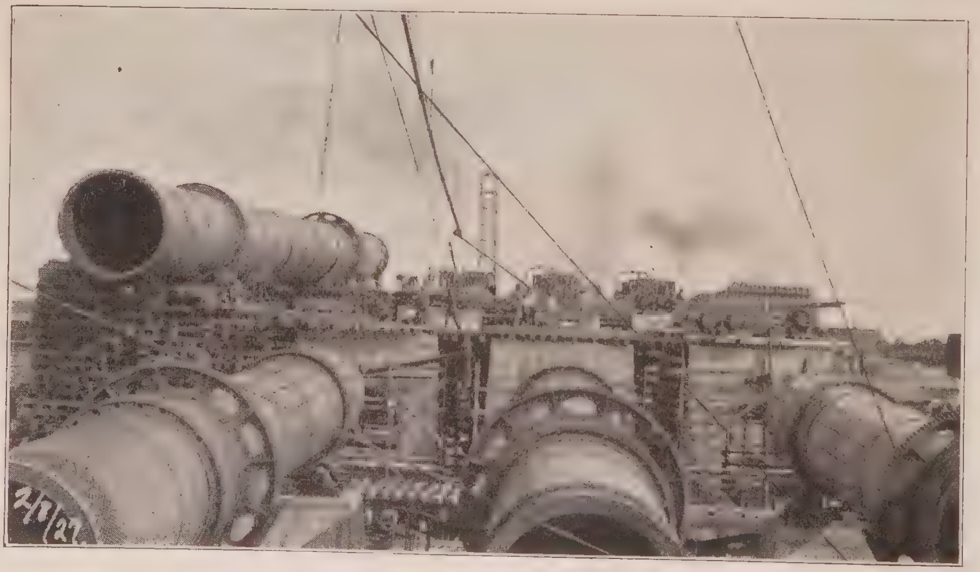
With approximately 500 men employed, work on the plant is going ahead rapidly. Most of the heavy units of machinery are already in place and construction of the buildings is under way.

Some illustrations, showing the progress of the work, are presented on this page and the next page.

The plant was designed by the Cowham Engineering Company of Chicago. The company will operate as the Florida Portland Cement Company.

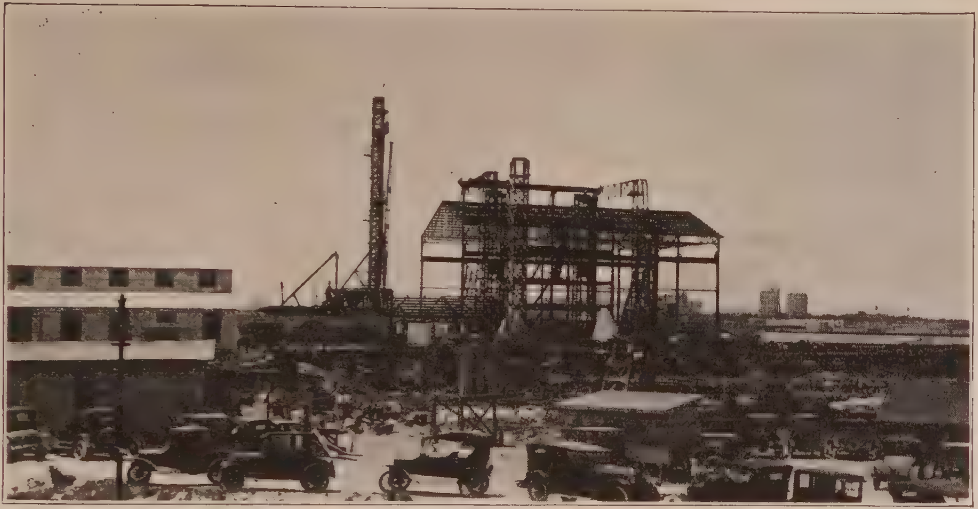


Construction of the grinding room and placing the mills. In the raw end there are three wet compeb mills. In the finish end there are four compeb mills equipped with air separators

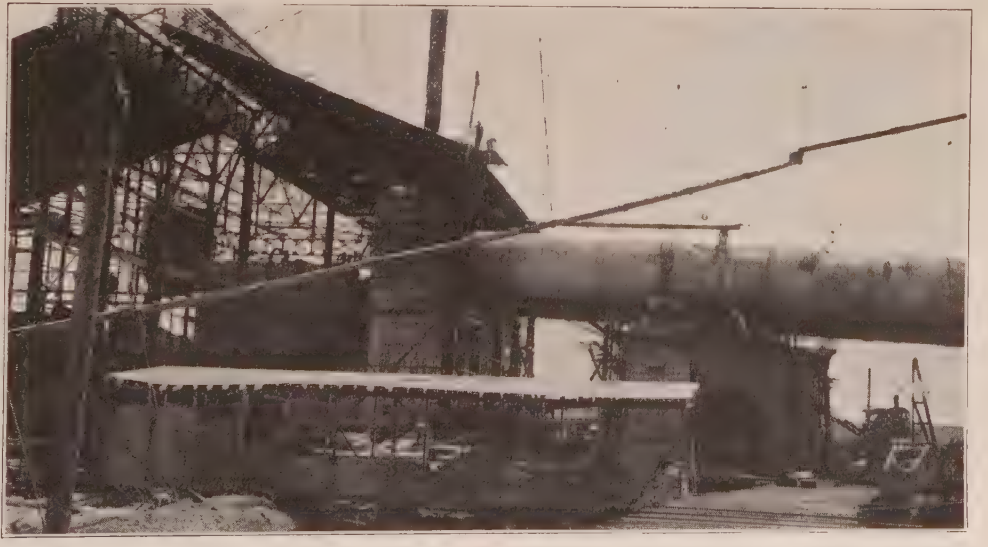


A general view of the kiln and cooler foundations with one kiln and three coolers in place. Three 11 x 175-foot kilns are being installed. The rotary coolers are 9 x 73 feet in size

Installing the waste heat boilers. Each kiln will be equipped with an Edgemoor water tube boiler with 9170 square feet of heating surface



A general view of the plant, showing the progress of construction. The capacity of the plant will be 1,500,000 barrels annually

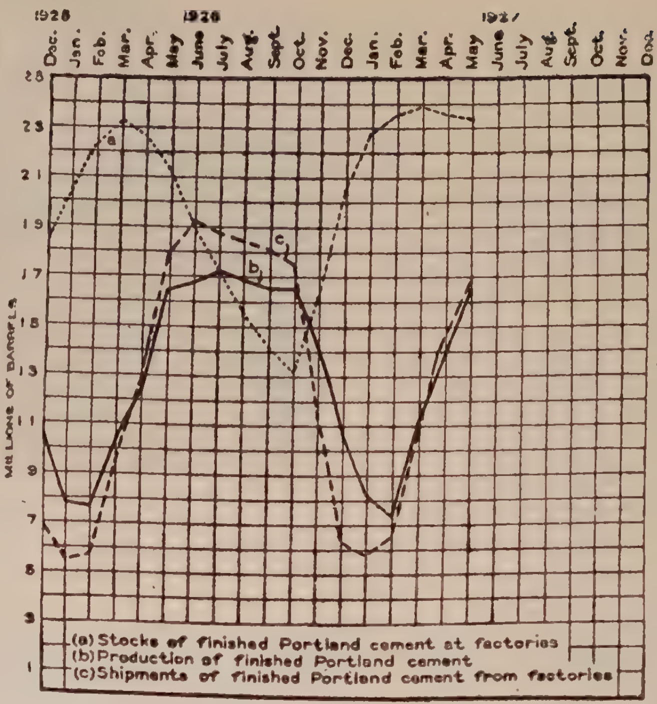


The feed end of the kilns, showing the waste heat boiler house framework

Cement Statistics for May

PRODUCTION of portland cement is the greatest in any May, and shipments have been exceeded only in one other—May, 1926, according to the Bureau of Mines, Department of Commerce. Portland cement stocks show a slight decrease but are still high and are 10 per cent in excess of the stocks at the end of May, 1926.

The output of two more new plants, located respectively in Tennessee and West Virginia, is included for the first time in these statistics.



Estimated Clinker (Unground Cement) at the Mills at End of Each Month, 1926 and 1927, in Barrels

Month	1926	1927
January	9,074,000	9,989,000
February	10,931,000	11,943,000
March	12,290,000	12,997,000
April	12,967,000	*13,335,000
May	11,695,000	12,492,000
June	10,144,000	
July	8,604,000	
August	7,362,000	
September	6,112,000	
October	5,370,000	
November	5,748,000	
December	7,799,000	

Production, Shipments and Stocks of Finished Portland Cement, by Months and by Districts, in Barrels

Month	Production		Shipments		Stocks at End of Month	
	1926	1927	1926	1927	1926	1927
January	7,887,000	8,258,000	5,674,000	5,968,000	20,582,000	22,914,000
February	7,731,000	7,377,000	5,820,000	6,731,000	22,385,000	23,560,000
March	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,922,000
First quarter	26,008,000	27,087,000	21,033,000	23,782,000		
April	12,440,000	14,048,000	12,965,000	14,350,000	22,710,000	*23,654,000
May	16,510,000	16,674,000	17,973,000	16,857,000	21,255,000	23,471,000
June	16,866,000		19,134,000		19,000,000	
Second quarter	45,816,000		50,072,000			
July	17,134,000		18,812,000		17,301,000	
August	16,995,000		18,583,000		15,718,000	
September	16,571,000		18,087,000		14,188,000	
Third quarter	50,700,000		55,482,000			
October	16,596,000		17,486,000		13,334,000	
November	14,193,000		11,276,000		16,243,000	
December	10,744,000		6,432,000		20,616,000	
Fourth quarter	41,533,000		35,194,000			
	164,057,000		161,781,000			

*Revised.

Commercial District	Production—May 1926	Production—May 1927	Shipments—May 1926	Shipments—May 1927	Stocks at end of May 1926	Stocks at end of May 1927	Stocks at end of April, 1927*
Eastern Pennsylvania, New Jersey, Md.	3,939,000	4,040,000	4,620,000	4,139,000	4,629,000	5,055,000	5,154,000
New York	861,000	1,006,000	928,000	956,000	1,418,000	1,673,000	1,624,000
Ohio, Western Penna., and W. Virginia	1,825,000	1,558,000	1,921,000	1,538,000	2,697,000	3,400,000	3,380,000
Michigan	1,290,000	1,558,000	1,301,000	1,431,000	1,915,000	2,195,000	2,068,000
Wisconsin, Illinois, Indiana, and Kentucky	2,238,000	2,189,000	2,598,000	2,336,000	3,456,000	3,130,000	3,277,000
Virginia, Tennessee, Alabama, and Georgia	1,428,000	1,456,000	1,420,000	1,453,000	1,068,000	1,146,000	1,144,000
Eastern Missouri, Iowa., Minn., and S. Dak.	1,518,000	1,440,000	1,777,000	1,382,000	2,819,000	3,289,000	3,231,000
Western Mo., Nebraska, Kans., and Okla.	1,116,000	1,037,000	1,131,000	1,070,000	1,430,000	1,723,000	1,756,000
Texas	454,000	462,000	447,000	573,000	515,000	314,000	425,000
Colorado, Montana, and Utah	273,000	246,000	256,000	227,000	347,000	506,000	486,000
California	1,233,000	1,364,000	1,259,000	1,423,000	526,000	570,000	629,000
Oregon and Washington	335,000	318,000	315,000	329,000	435,000	470,000	480,000
	16,510,000	16,674,000	17,973,000	16,857,000	21,255,000	23,471,000	23,654,000

*Revised.

EDITORIALS

Cleanliness

THERE is no longer any need for a cement plant to be dusty and dirty. New plants, in which an effort was made to keep the mill dustless, have shown that it can be done.

The popular conception that a cement plant is an undesirable addition to a community is not yet entirely overcome. And there are still many who believe that it is unhealthy to work in cement plants because of the dust.

Today, when there is an ever-growing tendency to locate cement plants in or near large cities, the item of cleanliness takes on added importance. If the advantages of proximity to the market are to be realized, an effort must be made to abolish the dust nuisance.

Neither need the yards and grounds of cement plants be the dirty, dusty places that they formerly were. It is possible to keep them neat and to landscape them as is done in some other industries. Such treatment would bring a very favorable reaction from the public. It would demonstrate that vegetation does not die because it is near a cement plant, and it would help do away with one of the objections against cement plants.

The favorable effect of clean, pleasant working conditions on the employee is well known. Accident statistics, too, have shown that cleanliness is an important factor in reducing lost time due to accidents.

There is a tendency in some of the mills to be a bit indifferent to the appearance of the plant and the grounds. A campaign to clean up and beautify the plant grounds would bring benefits from the organization itself and goodwill from the community in which the plant is located.

Where Progress Rules

IT is very gratifying to note the practical effects of the spirit of progress which characterizes the cement industry. One of the most significant of these is the way in which each cement plant to be built makes its own contribution to advancing technology of cement manufacture. There may be exceptions to this, of course, but as a rule, a new cement plant is in some way or another an improvement upon existing plants.

This was brought home to us with particular force a short time ago when two members of the staff of Concrete visited the new plant of the Phoenix Portland Cement Corporation at Birmingham, Alabama. Nothing of the wonderful was claimed for this plant, and yet—

Here were the longest kilns in the world, the largest grinding mills ever installed in a cement plant, the first double tube Unax coolers to be installed in any portland cement plant, special designs for much of the equipment, and other similar and unusual features.

The object of all this was not to build a sensational plant, but simply to make possible the production of the highest possible quality of cement at the lowest possible cost.

But that is not the whole story. When Mr. Lindley Morton, president of the corporation, spoke of the plant, he said that if a new plant were to be built now, it would be an improvement over the plant just completed. And it is in this spirit of constant improvement, this everlasting search for a better way of doing things, that there is to be found the explanation of the constant growth of the industry—a growth which nothing yet has been able to check.

The Safety Campaign

IN our last issue and in this issue will be found a number of news items dealing with the safety campaign which has been actively promoted in the cement mills. These items are not published as propaganda, but purely as news.

It seems to us that this in itself is a very important indication of the excellent progress that the safety idea has made in the cement industry. The prevention of accidents has come to occupy so considerable a share of the interest of cement mill executives that they expect to find reported in the columns of their business paper all of the various activities of individuals and of the industry as a whole which are aimed at the creation of safer working conditions within the mills. Here indeed is news,—and news of a mighty fine kind!

Statistics, of course, tell the same story that the news columns do. Accidents in the cement industry have decreased until today long periods of operation in individual mills without any accidents at all are not uncommon.

Nothing that the manufacturers could do alone would ever accomplish this. Only the whole-hearted co-operation of the men in the mills—of all of them from the commonest of common laborers up—could ever attain the result desired. And, incidentally, attained.

Mill executives have cause to be very proud of this record. For it is not a record of safety alone, though that in itself is no small thing. It is also a very definite evidence of the fine spirit which marks the cement manufacturing organizations, of the way in which executives and workmen co-operate, and of the intelligent acceptance with which the rank and file of the industry meet any really worth while demand.

MEN and MILLS

Notes from the Field

Start Building on Lawrence Plant in Maine

Mill to Be Completed Early in 1928; Day and Night Shifts of 400 Men Employed; Draining Flooded Quarry

Excavation is in full blast on the site of the new Lawrence Portland Cement Company plant near Rockland, Maine, and some actual construction has begun. Frank H. Smith, president of the company, and Vice President Charles Porter recently inspected the work.

All construction will be of concrete, using about 30,000 yards. A Maine Central Railroad crew has begun work on special tracks at the plant proper. Three miles of track will be needed to connect the plant's various branches with the main line of the railroad.

The main building will contain kilns 11 feet, 3 inches, by 200 feet. Adjoining the crusher, near the quarries, will be a sawmill, machine shop and blacksmith shop, housed in one building. The office and laboratory building will be 54 by 52 feet, and three stories high. The raw storage will measure 354 feet long, 100 feet wide and 70 feet high.

Work has also commenced on 19 storage bins, 90 feet high, as well as on garages, first-aid rooms, and a waiting station on the electric car line.

The ten-hour crew of 200 men was increased at the beginning of June to 400 men, half of which comprise the night shift.

Pumps have begun draining the quarry north of the plant. It had been abandoned for some time and is flooded with forty feet of water.

Joseph Taylor is superintendent of construction. Others in charge are Chief Electrician Howard Hieny, Consulting Engineer C. H. Sonntag, and A. C. Brunner, Chief Engineer of the Burrell Engineering Company.

Rumor of Consolidation False

The widespread rumors regarding a consolidation of the Lehigh Portland Cement Co. and the International Cement Corporation are now definitely known to be unfounded.

This has been established beyond doubt by an official announcement issued in order to put the rumor definitely to rest.

New Atlas Directors Are Elected

At the recent annual meeting of stockholders of the Atlas Portland Cement Company at Northampton, Pa., the following were elected directors: George T. Baker, Jr., George G. Bourne, Lowell R. Burch, Edward F. Carry, A. G. Croll, Thurlow M. Gordon, Henry Graves, Jr., Howard W. Maxwell, J. R. Maxwell, W. E. Miner, John R. Morron and L. H. Repass.

Further Plans for Missouri Mill

A later report than that which appeared in the May issue of CONCRETE concerning the proposed addition to the plant of the Missouri Portland Cement Company states that a $2,000,000 mill is planned. A structural steel and reinforced concrete kiln building is to be 40 by 400 feet.

It will have corrugated asbestos sidings and roof. Three batteries of concrete silos for finish storage, each having two silos conjoined, are included in the plans. Preliminary ground work has begun, and completion of the plant is scheduled for April, 1928. The F. L. Smidth Company, New York City, are engaged as engineers.

Veterans Celebrate Entry into Cement Field

Two veterans of the cement industry recently celebrated the twenty-fifth anniversary of their entrance into the business. F. De Murguiondo and Joe Pope Kelley in 1902 joined the first cement company in Dallas, the Texas Portland Cement and Lime Company. Mr. Kelley still remains with the Texas Portland Cement Company, which absorbed the old firm, while Mr. Murguiondo is with the Trinity Portland Cement Company.

Resolution Asks State Plant for Texas

According to a report from Austin, Texas, the state Senate has adopted a resolution requesting the State Board of Control and the Highway Commission to make an estimate of the probable cost of constructing a state cement plant. In support of the resolution, its backers point to the extensive road program being launched by the Highway Department and the fact that inasmuch as "adequate labor may be furnished by the state penitentiary to operate the plant, such an industry would probably save the state and counties much money in the construction of roads."

New Law Forces Shutdown to Reorganize Shifts

In compliance with a state law making a twelve-hour day prohibitory, passed on Friday, May 13, the Portland, Colorado, plant of the Colorado Portland Cement Company was compelled to shut down for several days during May in order to reorganize its shifts. The force was materially increased in the change from twelve- to eight-hour shifts. The problem was solved by the consolidation in part of the force released by the shutdown of the raw department at the Concrete plant a few days previous. The twelve-hour day had been in force for the past twenty years.

To Appoint Appraiser for Plant Ordered Sold

Failure to agree on the valuation of two plants owned by the Ideal Cement Company which were ordered sold by a federal court decree in December, 1924, has resulted in an order appointing an appraiser and authorizing the sale of the plants at public auction to the highest bidder. The government held the value of one of the plants at $1,200,000, while representatives of the corporation placed the figure at $3,000,000. The order affects the Concrete, Colorado, and either the Trident or Hanover, Montana, plants.

Wisconsin State Plant Bill Introduced

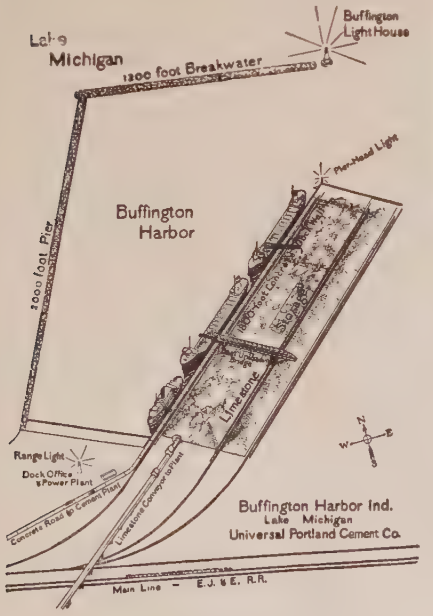
The state of Wisconsin will go into the cement making business if a bill introduced early in May by Assemblyman Wm. Coleman, Milwaukee, passes the legislature.

Universal Opens Harbor on Lake Michigan

Mary Elizabeth Hale presenting Vice President Dawes with the flag which was raised at the opening of the new Buffington Harbor. The other gentlemen looking at the young lady are, reading from left to right, her father, Mayor Hale of East Chicago, Blaine S. Smith and Mr. B. F. Affleck, vice president and president, respectively, of the Universal Portland Cement Co.

The Universal Portland Cement Company harbor at Buffington, Indiana, was formally opened to navigation on June 9th by Vice-President Chas. G. Dawes. Three thousand persons attended the opening as the guests of B. F. Affleck, president of Universal.

In addition to Vice-President Dawes, others of prominence who participated were U. S. Senator James E. Watson of Indiana, Congressman E. W. Sproul of Illinois, Mayor R. P. Hale of East Chicago, E. J. Buffington, president of the Illinois Steel Company, for whom the harbor was named, and T. W. Robinson, vice-president of that company, B. F. Affleck, and Blaine S. Smith, vice-president of Universal; A. F. Harvey, president of the Pittsburgh Steamship Company; Carl D. Bradley, president of the Bradley Transportation Company and the Michigan Limestone and Chemical Company, and A. F. Banks, president of the Elgin, Joliet and Eastern Railroad.



A feature of the event was the presence of two large freighters, the "T. W. Robinson" a self-unloading vessel, and the "Eugene J. Buffington," a standard steamer, each carrying 12,000 tons of Michigan limestone which was unloaded during the ceremonies.

Would Compel Government to Use American Materials

That the United States government should specify American materials in calling for bids on government construction will be the purport of a resolution to be introduced in the next Congress. Senator Edwards of New Jersey is reported to have agreed to sponsor the resolution if manufacturing and other business interests desire it. At the last short session of Congress a similar resolution introduced by Congressman Wood of Indiana received little consideration because of press of business.

Southwestern Installs More Equipment

Installation is being made at the Osborn, Ohio, plant of the Southwestern Portland Cement Company of a new turbine, boiler, kiln and coal mill. The output will be considerably increased when the installation is completed, about the fifteenth of July.

Mitchell Plant Dedicates 1926 Trophy

The dedication of the national trophy won by the Mitchell mills of the Lehigh Portland Cement Co., Mitchell, Indiana, was observed on Saturday, May 28. A majority of the workers attended the ceremonies. The plant, with 900 employes in quarries and mills, went through 1926 without the loss of a single hour from accident.

The trophy was erected on the campus at the Mitchell plant. It is a huge block of precast concrete, eight feet high and 16,000 pounds in weight. Its face is embellished with a classic design and the motto, "Safety Follows Wisdom." A carved inscription below gives the date and significance of the award.

The Mitchell plant again has a clear record, as far as the first six months of 1927, and is working to maintain this record.

"B. F. Affleck" Launched at Toledo

The Pittsburgh Steamship Company boat "B. F. Affleck" was launched at Toledo, Ohio, June 25th. It is named for the head of the Universal Portland Cement Company.

The boat will carry limestone from Michigan to steel and cement plants at Chicago, Buffington, Gary, Lorain and Duluth.

The freighter is a 12,000-ton vessel, 604 feet long and 60 feet wide. Motive power includes a triple expansion engine and three Scotch Marine boilers.

Pacific and Old Mission Consolidated

An official announcement makes known the consolidation of the Pacific Portland Cement Company and the Old Mission Portland Cement Company into a new corporation to be known as the Pacific Portland Cement Company. Capital is placed at $30,000,000. The company will operate plants at Redwood City, San Juan Bautista, San Benito County, and at Cement, Solano County, all in California, as well as two plaster plants.

Plans Completed for White Cliffs Mill

Construction will commence very shortly on the 500,000 bbl. per year capacity plant at White Cliffs, on the Little River, Arkansas, according to an announcement by the Lime Products Company. The cost is estimated at $1,392,000 and the plant will employ 100 men. It will be located on the Graysonia, Nashville and Ashdown railroad, which connects at Nashville with the Missouri Pacific and at Ashdown with the Kansas City Southern and the Frisco railroads.

Plants Hold Ceremonies at Raising of Green and White Safety Banners

Although tabulations of actual results of the June safety campaign are not yet available, the ceremonies which took place at the raising of banners at plants are of interest.

The machine shops of the Nazareth Portland Cement Company, Allentown, Pa., were the scene of a program under the direction of F. B. Hunt, electrical superintendent of the plant. A comparison of the 1926 Nazareth accident record with that for the first five months of 1927 was made by W. W. Ritter, state engineer of the state workmen's insurance fund. Mr. Ritter's remarks were interpreted to employes by John Bolez in Slovak, by Wendel Caffner in Hungarian, James Avati in Italian, and Albert Garr in Pennsylvania German.

The Lehigh plant at Union Bridge, Maryland, held a meeting of its employes and the public on a local college campus. A short address was made by John P. Rostmeyer, Assistant Director of the Baltimore Safety Council. A concert was provided by the Union Bridge Band.

The Lawrence banner at Northampton was raised at noon by "Stackhouse" John, the oldest employe with the company in point of service. No lost time accident has been scored against his record in thirty years of service.

The San Antonio Portland Cement Company plant at Cementville, Texas, was particularly anxious to make a good record, since it was awarded the first safety trophy offered by the Portland Cement Association, in 1923, in competition with other United States, Canadian and Cuban plants.

Northwest Reports Shipments Above Normal

An increase of approximately 29 per cent in the number of cars of cement to be loaded during July, August, and September this year compared with the same months last year is revealed in a forecast made by the Cement and Concrete Products Committee of the Pacific Northwest Advisory Board of the American Railway Association.

The area for which this forecast is made includes Washington, Oregon, and Idaho north of the Salmon River. The commodity committee makes its forecast for each quarter of the year. The record of the previous three months shows actual loadings to have varied from the committee prediction by one-tenth of one per cent.

Gordon Tongue of the Superior Portland Cement, Inc., with headquaters in Seattle, is chairman of the cement and concrete products committee of the board. In the estimate for July, August, and September car shipments Chairman Tongue states that a total of 5984 cars will be filled.

Work Yosemite Quarry for First Time

A supply of limestone for the Yosemite Portland Cement Company plant at Merced, California, to begin operation in the near future, was secured in a spectacular blast made on May 23. Fifteen tons of dynamite ripped off the face of a mountainside located sixty miles from Merced, the debris falling into a ravine 800 feet below. The stone will be conveyed to the plant by train.

Approximations place the limestone available at a quantity sufficient to keep the plant in capacity operation for a century.

San Antonio Makes Record Shipment of 57 Cars

A record trainload of cement was shipped recently over the Southern Pacific from Dallas, Texas, direct to the lower Rio Grande Valley over the shortened route made possible by the San Antonio and Arkansas Pass extension.

The shipment consisted of 57 cars of cement from the Trinity Portland Cement Company plant at Dallas to Harlingen. There the consignment was broken up for distribution throughout the valley.

To Use 90 Tons of Dynamite for Mountain Blast

The Monolith Portland Cement Company of California is preparing to blow up a mountain in Tehachapi Valley, midway between the towns of Tehachapi and Monolith, with ninety tons of dynamite early in July.

According to reports the blast will be the biggest that has ever been set off in Kern County and one of the biggest ever fired on the Pacific Coast. In August, last year, a giant blast was set off near Monolith using only sixty tons of dynamite.

The entire face of a mountain of lime will be lifted into the air and dropped into a 750,000-ton heap of rock that will feed the kilns for a year and a half.

Railroad Builds Concrete Road to Plant

The Central Railroad of New Jersey is building a reinforced concrete entrance driveway to the Lawrence Cement Company's plant at Siegfried station (Northampton), Pennsylvania.

The work is being done by the railroad's forces, under the direction of William Twining, Engineer, Maintenance of Way.

NORTH AMERICAN CEMENT CORPORATION
NORTH AMERICAN CEMENT CORPORATION

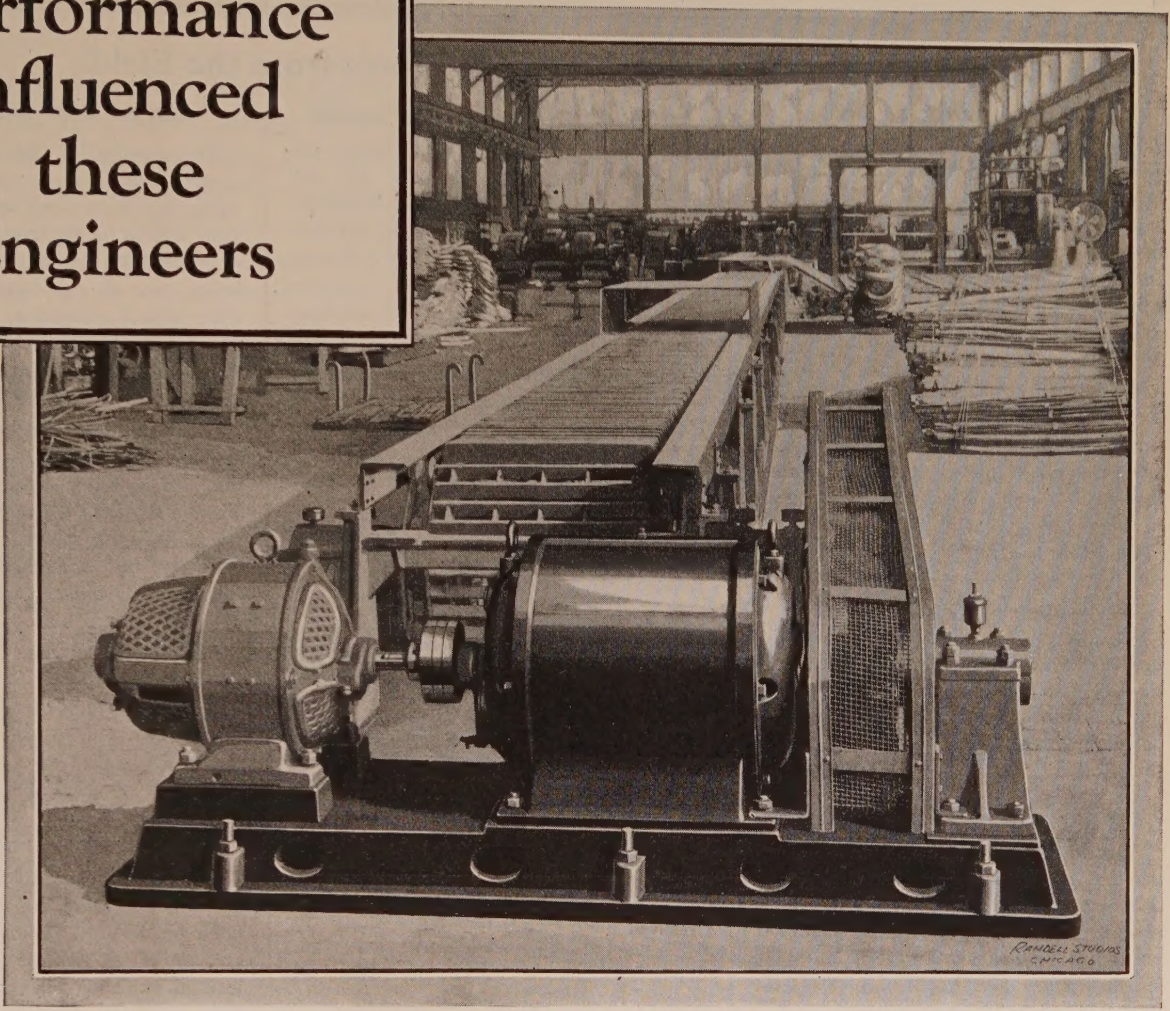
Inter-Plant Trophy

This is the trophy won for its 1926 no-accident record by the Berkeley plant of the North American Cement Corporation in the latter's inter-plant competition. In 1923 the Berkeley plant man-hours lost per 100,000 man hours worked were 1056.3. In the two years following they were cut to 186.3 and 123.

In 1926, for the first time, work toward increased safety was guided by a General Safety Committee. This Committee consisted of the General Director of Safety as chairman and the local plant safety directors as members, together with the company statistician acting as secretary. The committee meets quarterly. It does not in any way attempt to supervise the work of the plant safety committees but permits them to carry out their own ideas. It acts as a medium for the interchange of ideas between the various plants, as an arbiter to decide questionable accidents, devises and conducts contests between plants, and also sees that proper records are kept and distributed in connection with the accident prevention work.

Known Performance influenced these Engineers

Jones Spur Gear Speed Reducer installation in steel mill. Variable motor speed 500-1500 R. P. M. Ratio in reducer 125.4 to 1. Chain drive from reducer to conveyor



Recently three large engineering companies submitted bids on the mechanical equipment of a large factory. On all Spur Gear Speed Reduction drives Jones Spur Gear Reducers were specified by each of these three engineering companies. Naturally they were installed.

These engineering companies, designers and builders of many kinds of machinery, knew from their own actual experience on many types of drives that no spur gear speed reducers measured up to all the requirements so completely as Jones. You can accept their judgment for it is the unprejudiced judgment of engineers who are constantly seeking for the best.

If you are planning to install modern speed reduction drives in your plant be sure to get complete information on Jones Speed Reducers. They will save you money in installation costs, in operation and maintenance expense, protect against personal injury and help to increase the efficiency of your working force.

Jones Speed Reducers

W. A. Jones Foundry & Machine Company
Main Offices and Works: 4414 West Roosevelt Road, Chicago

Branch Sales and Engineering Offices:
New York Cleveland Milwaukee Pittsburgh Buffalo Detroit
Birmingham St. Louis Cincinnati Peoria Los Angeles San Francisco

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With the Manufacturers

Industrial Literature

"Engineering Index"

The 1926 edition of "*The Engineering Index*" published by the American Society of Mechanical Engineers is now being distributed. Beside covering items on mechanical engineering which appeared in its own and other publications, it includes references to those on chemical, civil, mining, metallurgical and electrical engineering.

Jeffrey Fans

Safeload fans for power house and general use where air is necessary against medium to high pressures are described in *Catalog No.* 440 published by the *Jeffrey Manufacturing Company*, Columbus, Ohio.

Laclede Fire Brick

The use of "*Laclede-Crown-Special*" fire brick is suggested for refractory conditions where "first quality" brick have proven unsuccessful, in a four-page folder published by *Laclede-Christy*, St. Louis, Missouri.

Paper on Powdered Coal

"*Recent Developments in Burning Powdered Coal Under Steam Boilers*," is the title of a paper presented before the International Conference on Bituminous Coal by Henry Kreisinger, Research Engineer for the *Combustion Engineering Corporation*, and reprinted by that firm.

Fawcus Booklet

A new line of *Fawcus* worm gear speed reducers are covered in *Bulletin E*, published by the *Fawcus Machine Company*, Pittsburgh, Pennsylvania.

Apron Conveyor Catalog

Jeffrey standard apron conveyors are featured in the *Jeffrey Manufacturing Company Catalog No.* 435, now being distributed. The publication includes tables of special specifications and typical layouts giving general dimensions.

Second Edition of Catalog

The W. A. Jones Foundry & Machine Company, Chicago, advises that it has just issued the second edition of its *No. 26* spur gear speed reducer catalog.

Refractory Products

The April issue of the *Laclede-Christy* booklet illustrates the use of its fire brick and other refractory products in the manufacture of boilers and glass.

Notes from the Field

Stephens-Adamson in Canada

A complete manufacturing plant was placed in operation recently by the *Stephens-Adamson Mfg. Co.*, at Belleville, Ontario, Canada. From this branch factory there is supplied the entire S-A conveying machinery line for the Canadian trade, in addition to a general export business to foreign markets.

Mr. G. A. Freeman, for fifteen years associated with the main organization in an executive capacity at Aurora, Illinois, is in charge of the new plant.

Pacific Coast Manager

William B. Senseman has been appointed Pacific Coast district manager for *Combustion Engineering Corporation, Raymond Bros. Impact Pulverizer Co., Ladd Water Tube Boiler Co.*, and *Heine Boiler Co.*, all subsidiaries of the *International Combustion Engineering Corporation.*

The new consolidated offices are located in the Subway Terminal Building, 417 South Hill St., Los Angeles, California.

Westinghouse Appointments

The Westinghouse Electric and Manufacturing Company announced recently the appointment of *Mr. J. P. Alexander* as Boston Manager in charge of all sales and service in New England.

George H. Cox, who has been New England Manager for the past eight years, has been appointed Sales Manager at the South Philadelphia Westinghouse Works in charge of the sales of all the products manufactured at that plant including steam turbines, condensers, Diesel engines, etc.

Consolidation of Offices

The Edge Moor Iron Company announces that its New York sales office, with *Messrs. J. F. Glenn* and *H. M. Lodge* in charge, and the *Waste Heat Consulting Engineering* office, in charge of *Mr. F. Falla*, have been combined. The address is 827 Graybar Building, New York City.

Officers Re-Elected

At the annual meeting of the *Timken Roller Bearing Company*, held at the main plant, Canton, Ohio, on Tuesday, April 19, all the present officers were re-elected for another year.

Large Kiln Installations

The opening of the Phoenix Portland Cement Company plant at Powderley, Alabama, has placed into operation two rotary kilns said to be the largest revolving pieces of mechanism in the world, as well as being two of the largest cement kilns. They were furnished by the *Traylor Engineering & Manufacturing Company*, and measure 11 feet 3 inches to 10 feet in diameter, by 343 feet 9 inches long.

Other interesting Traylor installations are a 11-foot 3-inch by 300-foot kiln on four single roller supports, built for the Trinity Portland Cement Company, Houston, Texas, and a bottle type kiln 240 feet long for the Missouri Portland Cement Company. Diameters are similar to those of the Phoenix kiln.

Both the Victorville, California, and the Osborn, Ohio, plants of the Southwestern Portland Cement Company have been furnished with a 7 by 40-foot three-compartment mill.

E. C. & M. Representatives

The Electric Controller & Mfg. Company of Cleveland, Ohio, announces the appointment of the firm of *Mr. J. B. McCarthy* and *Mr. W. P. Robinson* as representatives in Canada. Their offices are at 307 Reford Bldg., Toronto, Canada, and 808 Drummond Bldg., Montreal, Quebec, Canada.

The Electric Controller & Mfg. Company announces the appointment of the *Petroleum Electric Co.*, 217 East Archer Street, Tulsa, Oklahoma, as its representative in Oklahoma and the Pan Handle District of Texas.

Whitcomb Representatives

The Geo. D. Whitcomb Company, Rochelle, Illinois, manufacturers of *Whitcomb* gasoline and electric locomotives, announce the appointment of the Clyde Company, 309 Magazine Street, New Orleans, Louisiana, as representatives for Louisiana and the southern halves of the states of Mississippi and Alabama.

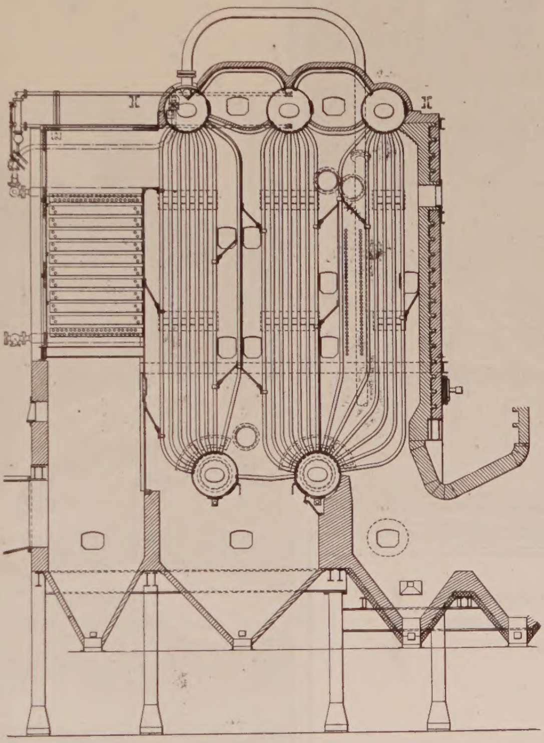
Brown Branch

The Brown Instrument Company has recently opened a branch office at 718 First National Bank Building, Cincinnati, Ohio. *Mr. J. R. Green* is the district manager.

WASTE-HEAT BOILERS

THE BABCOCK & WILCOX CO.

SAVING the heat in high-temperature waste gases, by raising steam with them, is very old. As long ago as 1874 The Babcock & Wilcox built its first boiler for that purpose. Many others were built after that early installation was made and they saved so much money previously spent for unnecessary boiler fuel that in 1913 the Babcock & Wilcox engineers undertook an elaborate investigation to ascertain if it was economically practicable to raise steam with gases of lower temperature than those previously utilized in this way. This led to the design of the high gas-velocity boiler, in which the hot waste gases are drawn at a rapid rate over the heating surfaces of the boiler by a fan.



Babcock & Wilcox Five-Drum Waste-Heat Boiler and Economizer, the Type Installed at the Acme Mill of the North American Cement Corp.

The Babcock & Wilcox boiler installed at the Pencoyd works of the American Bridge Co. in 1913 was the first to use high gas velocities in the United States. In 1915 The Babcock & Wilcox Co. installed at the Speeds mill of the Louisville Cement Co. the first waste-heat boiler utilizing the principle of high gas velocities to be employed in the cement industry.

Since 1913 the company has installed about 200,000 H.P. of such waste-heat boilers in various industries, which is believed to be over three-fourths of the total installed in this period in this country.

They are used not only in the cement industry but also with open-hearth steel furnaces, heating furnaces, furnaces for refining non-ferrous metals, gas benches, oil stills, glass tanks and other plants yielding large volumes of waste gases of sufficient temperature to make their use advisable. The value of this broad experience, in recommending designs of waste-heat installations for new plants. is evident.

In 1925 The Babcock & Wilcox Co. brought out the five-drum type of waste-heat boiler. It was designed for use where it is desirable to install the maximum amount of heating surface on a given floor area and to have the minimum draft resistance through the boiler for a specified rate of heat transfer. As the dust in some kinds of waste gases has been a cause of trouble in a few plants, the vertical position of the tubes in this type of boiler is advantageous, in such cases, in checking the collection of the dust on the heating surfaces. In addition, the construction is such that the exterior of each tube can be cleaned by hand if necessary.

As a further safeguard against trouble from dust, there is a flat arch inclined downward at the front of the boiler, which causes a large part of any dust in the entering gases to collect in the hopper below the first pass. Experience shows that this arch has a further advantage in that it equalizes the flow of gases across the entire width of the boiler.

Main Offices: New York, 85 Liberty Street

Branch Offices: Atlanta, Candler Bldg.; Boston, 80 Federal St.; Chicago, Marquette Bldg.; Cincinnati, Traction Bldg.; Cleveland, Guardian Bldg.; Dallas, Magnolia Bldg.; Denver, 444 Seventeenth St.; Detroit, Ford Bldg.; Los Angeles, Central Bldg.; New Orleans, 344 Camp St.; Philadelphia, Packard Bldg.; Phoenix, Heard Bldg.; Pittsburgh, Farmers Deposit Bldg.; Portland, Ore., Gasco Bldg.; Salt Lake City, Kearns Bldg.; San Francisco, Sheldon Bldg.; Seattle, L. C. Smith Bldg.

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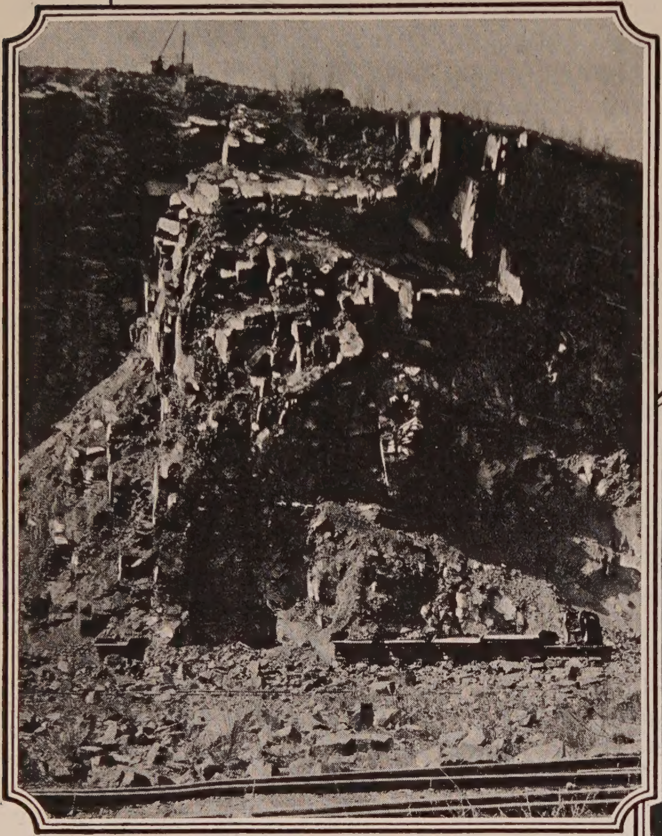
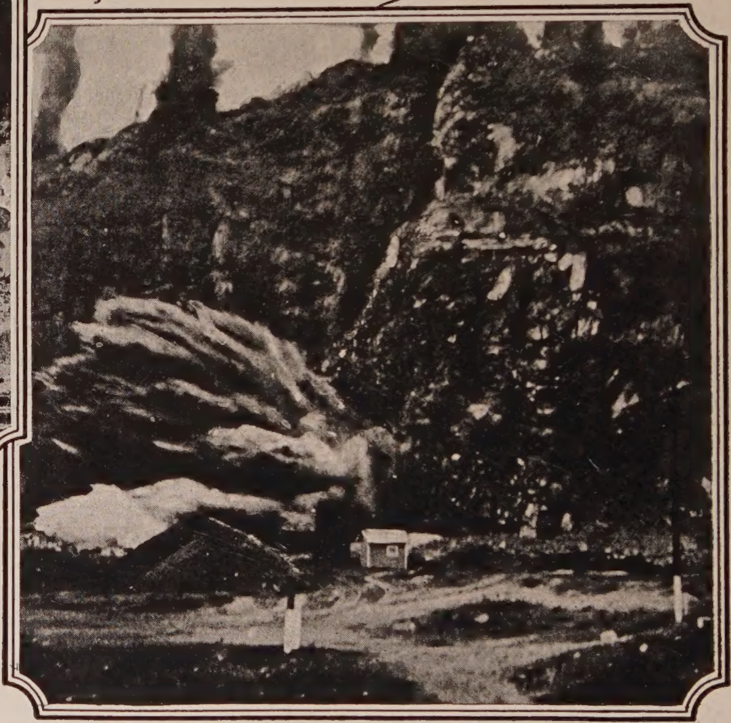
THE 125TH YEAR



Portion of face of quarry at Birdsboro, Pa. 250 feet high and 900 feet long. Distance from edge to breaking line 40 feet.



The big shot in progress. The first time in this country that the well-drill holes and coyote tunnel loading methods were used simultaneously.